POWER

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Who Shall Rule?

WE live in a world of growing complexities and possibilities.

There are so many things to know that nobody can know all of them.

Expert knowledge of some on the part of somebody is essential; but the specialist digs himself out of view of the wide perspective and becomes to collective activity what the operator of a special tool or the conductor of a repetitive process is to mechanical engineering.

Who, what class of people are to be the world's guides, the co-ordinators, the all-knowing ones who can see above the mass of detail and local or personal interest and realize the possibilities and trends of the world's progress?

Is there need of a leisure ruling class, and if so what provision is there for seeing to it that their leisure is employed in the broadest and best kind of service?

Ruling, governing, is not now and is continually getting to be less like what it used to be. It has come to be, or to need to be, more a wise conservation and development of the nation's resources and an intelligent management of the nation's finances and housekeeping.

To do this effectively requires something more than the iron will and nerve of the conqueror or the popularity-winning or safely servile qualities of the politician.

We need nation managers developed, in a larger way, along the same lines that city managers are; people wise in the lessons of history and the examples of other civilizations, versed in finance, practical in the processes of industry, transportation, exchange and distribution, who can co-ordinate the intricate movements of our complicated experience so that our available man-power may never lack opportunity for the satisfaction of its own needs and the work of the nation be consummated with the greatest economy, efficiency and dispatch.

In the meantime, shorter hours, more general literacy, greater accessibility of information and better facilities for the interchange of thought and information enable the average man to know more of the world in which he lives, complex as it is, than any, save the exceptional man, knew of the simpler world a few years ago.

EDITORIALS

Bankers and Business

PRESIDENT HOOVER'S speech before the American Bankers Association last week struck a powerful note—one upon which economists are generally agreed.

The President, however, has the national position with which to proclaim the responsibility of the banks in the present situation. Practically all business, and certainly all big business, has as its inception the helpful and co-operative confidence of the banking interests. As the banks supply the sinews of business, their words and attitude, their confidence or lack of it are a potent influence in the prosperity marathon.

While the words of the President are still fresh, business should put the issue squarely up to the banks. Many have pending programs that will click when the minds of the parties at interest meet—

Let's go!

New York Awakens to Its Smoke Nuisance

IT HAS been estimated that New York City forfeits forty per cent of its sunshine because of smoke. Anyone doubting this has but to ascend the tower of the Chrysler Building. Unless the day be windy, it will be impossible to obtain a view of the city. Hanging low over the streets there will be seen a haze of blue, the contribution of numberless automobiles. Above this, scattered whiffs of smoke curl lazily from buildings to mark the location of incinerators and improperly fired boilers. Here and there the tall stacks of utilities and other power plants are emitting smoke of varying intensity or streams of fly ash that diffuse over Long Island. The rivers and the bay also contribute their share; not only the numerous tugs and other harbor craft but huge liners that belch veritable smoke screens when getting under way. Added to this are the fumes from refineries and chemical works along the New Jersey shore which pollute the atmosphere of the outlying districts.

Twenty-five years ago New York was regarded as a clean city. Today, it ranks among the smokiest. The pollution of its atmosphere may be taken as an indication of increased use of energy through a period during which no organized effort was made to meet these cumulative conditions.

It is encouraging that steps are now being taken to cope with the situation. Health Commissioner Wynne has set his hand to the task and has appointed a sizable staff of inspectors and a smoke trial board which has already brought before it a number of offenders. The Commissioner has the active support of the local Chamber of Commerce and other civic bodies. It is understood that the campaign will be waged along educational lines and attention will be directed to the economic loss resulting from improper combustion. Only where the offender refuses to co-operate will the penalties of the law be invoked.

The problem is one that concerns the whole metropolitan area, and involves both smoke and atmospheric pollution from noxious fumes. Because of the many contributing factors, the campaign, to be successful, must be predicated upon systematic investigation and research. Commissioner Wynne has a strong ally in the Stevens Institute of Technology, where there has recently been endowed a chair of smoke abatement research. To this chair has been called Colonel E. H. Whitlock, a recognized authority on the subject, who for several years past has directed smoke abatement work in Cleveland.

Stupendous as the task is, it is not insurmountable. Several years may be required to again place New York in the class of clean cities, but it can be done if everyone will co-operate.

The Personal Factor

ENORMOUS MENTAL ENERGY has been expended during two centuries in bringing the steam engine to its present perfection. Since the time of Faraday, and earlier, the brain of genius has been steadily at work on the problem of electric generation and distribution, and today we have the issue of all that study in the up-to-date power plants.

When purchasers install modern machinery, they are swayed to do so principally because of the high efficiency promised. But when picking a man to look after the equipment and see that it fulfills the anticipated efficiency, they often will take little note of his personal factor, of whether his individual efficiency rates high or low. There never was a time when the question of personal efficiency was so important as it is today.

On the other hand, there is scarcely a man in business who cannot sparkle if he will but throw off the lethargy which, more likely than not, is keeping his personal efficiency at low ebb. Let him but exercise his thinking faculties, concentrating on ideas for adapting to present needs the conditions with which he finds himself in contact, and his rise to higher responsibilities and better reward will be assured.

Breakdown Facilities

IN STUDYING diesel office-building power plants, as so many building corporations are nowadays, the determination of plant capacity appears to be a serious problem; one for which engineers by no means find identical solutions.

An industrial plant is seldom faced with an uncontrollable peak load, consequently the power plant can be designed with a capacity considerably below that called for by any peak that might occur if unrestrained. Even if a breakdown occurs the factory alone suffers.

On the other hand, the office-building plant is subject to uncontrollable peaks, and continuous service is an essential public requirement. This makes the determination of plant capacity more difficult. If engines are installed of a capacity just equal to the maximum peak that may occur, service will be crippled should one unit be disabled, and the installation of an additional unit for stand-by is a heavy burden.

One solution is to establish a breakdown connection with a public utility. This, however, is objected to by those who desire a self-contained power source. Others suggest that diesels be arranged for supercharging on peak loads, thereby increasing their capacity. Unless provisions be made for alteration of the clearance volume, maximum pressures may be too high, and temperature stresses may go beyond safe values. So far no one has offered a suitable volume-changing device, although such an arrangement has been used to permit semi-diesel engines to start as spark-ignition engines.

Speed-changing devices may be applicable, but so far have been used only on direct-current generator sets, which, it happens, are employed generally in office-building plants. The objection raised to this is that if an engine is built to successfully operate at twice normal speed, the manufacturer errs in not normally employing the higher speed. But an engine may easily operate for a few hours at a speed far beyond the safe continuous one.

From many aspects, the most logical solution will be found in the installation of a low-price gas- or gasoline-engine stand-by unit. Such engines sell at prices one-half to one-third those of diesel engines, and their high speed permits the use of low-cost generators.

Providing an Adequate Elevator Service

TRENDS in modern elevator installations are toward making the service as nearly automatic as possible. Practically every consideration is in favor of doing this.

To keep the number of elevators at a minimum and render an adequate service means high car speeds and high rates of acceleration and retardation, with accurate landing at the floors. This makes automatic control practically imperative.

But an adequate number of elevators of proper design is not sufficient in itself to insure good service. The cars must be operated on a suitable schedule, and their efficiency is judged by how closely this schedule is maintained. This requires automatic scheduling of the cars and means whereby the dispatcher may relieve individual cars of temporary service peaks. Such an elevator system is described in this number. The calls are answered automatically when buttons are pressed in the car or corridors. The operators, thus relieved of the responsibility of making landing stops, are free to attend to requests of the passengers. The dispatcher has before him an indication of the cars' positions and how closely they are running on schedule. With this set-up, a uniform service is rendered even though the demands may vary.

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POWER *Stands for . .*

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason

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Experience with

HIGH-PRESSURE BOILERS In Central

Following the World Power Conference the author visited a number of high-pressure plants from which he obtained first-hand information. An account of the observations made is presented in this, the first of a series of two articles

AMONG the high-pressure boilers of special design the Loeffler boiler[1] has recently received considerable attention. Both Loeffler boiler installations, the oldest one at Florisdorf, Vienna, Austria, and the one at Witkovitz in Czechoslovakia were visited. At the Florisdorf works the Loeffler boiler, placed in operation more than four years ago, is still working very satisfactorily. The plant is started up every week-day, running thirteen hours each day and carrying the entire plant load. Only on Monday mornings is it required to start with the aid of the auxiliary boiler, when it takes about 2½ hr. to bring the boiler to full pressure. Other days, however, the auxiliary boiler is not required as the boiler pressure drops to only 600 lb. during the night. Full pressure is then reached in about 1¼ hr.

Changes in the installation have been few and of minor importance except for the addition of a radiant superheater. This superheater, shown in Fig. 2, was installed by cutting open the bottom loops of the first-pass superheater and welding on the radiant superheater tubes, which are made of 5 per cent molybdenum steel. The fact that an alloy steel was used, it was explained, should not be looked upon as an admission that alloyed steels are necessary for high-pressure radiant superheaters. It was used solely because the reduced wall thickness made possible by the use of such alloy assures higher heat transfer and lowers the resistance to flow, resulting in lower power requirements for the circulating pump. The use of alloy steel is, therefore, justified, especially since the higher cost of the alloy steel is somewhat offset by reduction in weight.

Only one man is in charge of this boiler. Various devices, which can be seen in Fig. 1, guide his operation. A large pointer on a horizontal scale at the boiler front indicates the steam temperature; signal lamps arranged above this scale warn him with a red flash when the superheat is too high. The temperature is kept between 847 and 896 deg. F. The high limit is set only in consideration of the steam engine, the boiler having proved capable of satisfactory operation with steam temperatures up to 986 deg. F. A constant check is also kept on the superheater tube wall temperature, which the attendant reads on the two vertical scales seen on either side of the coal chute. This reading is derived from the expansion of a superheater tube arranged as shown in Fig. 2. This same device opens a bypass blow-off valve if by accident the attendant should fail to notice an undue rise in temperature, and causes saturated steam to escape from the evaporator through the superheater to roof, thus cooling the superheater.

If the pressure should drop following an increase in load, the speed of the circulating pump is raised, simultaneously increasing the delivery of the feed pump which is driven from the same shaft. A stroke adjustment of the feed pump is used only to take up lag or to change the basic superheat relation. The fire is then adjusted to maintain the desired superheat. Obviously, the boiler is readily adaptable to auto-

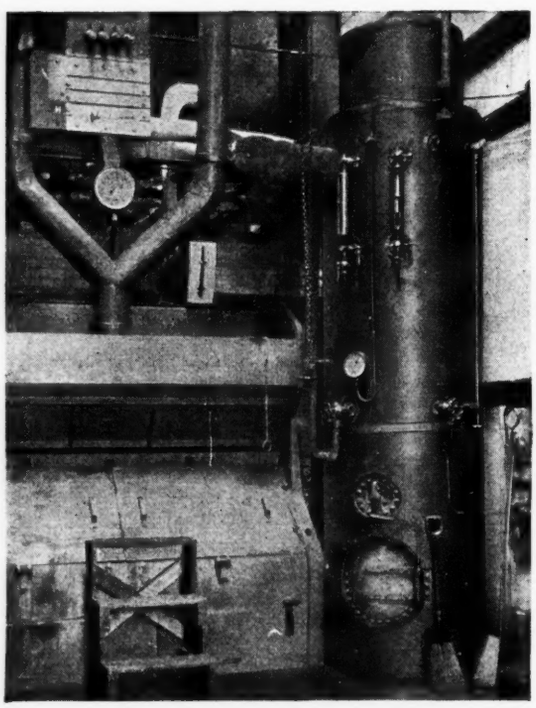

Fig. 1—Loeffler boiler at Florisdorf with auxiliary starting boiler at right

[1]Articles on the Loeffler boiler appeared in *Power*, Dec. 29, 1925; March 26, 1929; Oct. 29, 1929, and March 6, 1930.

Europe

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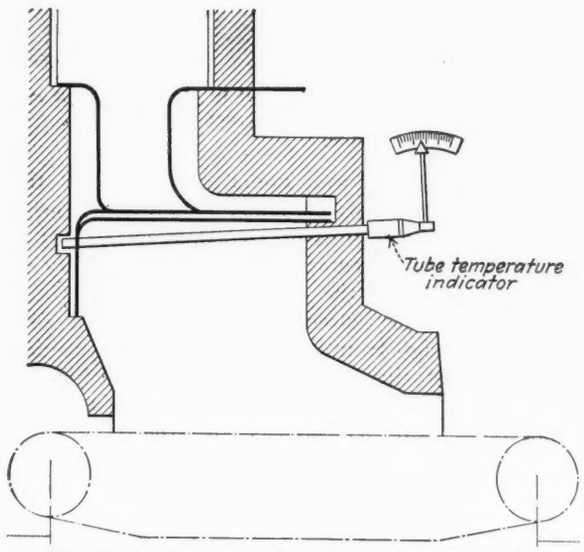


Fig. 2—Arrangement of radiant type superheater added to Florisdorf boiler. Pointer at right indicates the superheater tube temperatures

matic control. With hand control the pressure did not vary more than three per cent.

Some remarkable records are attained with this installation. On an average 2,200 lb. of hard coal are burned on 100 sq.ft. of traveling grate area with only 420 cu.ft. of combustion space, equivalent to a heat release of more than 70,000 B.t.u. per cu.ft. The air preheating temperature had to be reduced to 320 deg. F. to permit such high furnace loads without undue maintenance expense.

Since the installation of the special-alloy, pressure-lubricated metallic packing, the circulating pump has given no further trouble and proved to be so reliable that the thought of installing a spare was discarded. The steam loss through each packing is only 8 lb. per hour. The lubricating oil is recovered. The water-lubricated steam cylinders show no appreciable wear, while the piston rings have worn only 0.005 inch.

The boiler feed water has a hardness of three grains per gallon. When the evaporator was blown at noon, one could see that the water coming out at the beginning had quite a discolored appearance, indicating high concentration. Attention was called to the fact that, even when the evaporator was not blown down for a few days, thus driving the concentration to the point of having the water in the evaporator appear like a milky substance, no indication was found that deposits would form in the boiler tubes. It should be remembered, however, that the first-stage economizer of this boiler is heated indirectly. It is claimed that, with the economizer temperature below the steaming point and with high velocities, no scale formation would take place with the quality feed water used at present if the economizer were heated directly. The indirectly heated economizer stage was installed with the view of obtaining data for the locomotive.

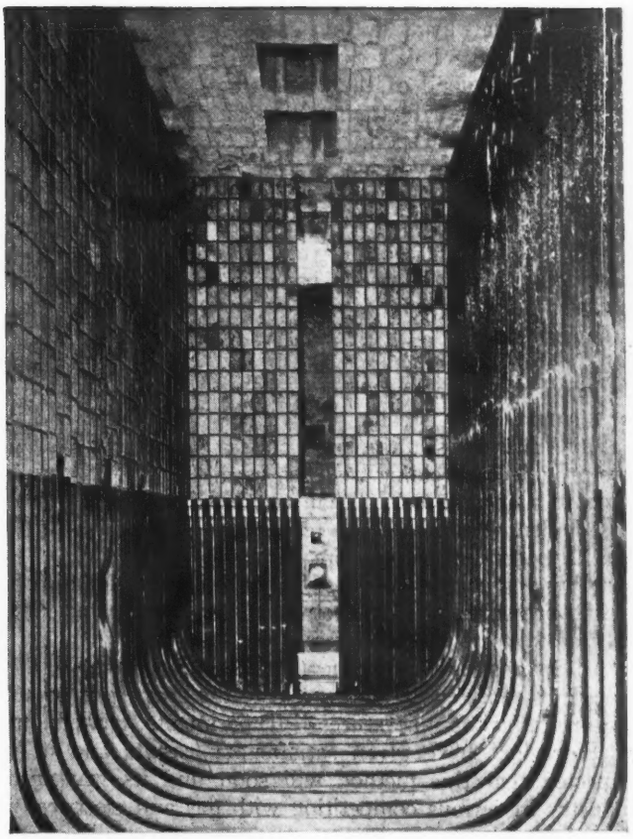


Fig. 3—Gage type radiant superheater of new 100,000-lb. Loeffler boiler

None of the valves and fittings, as well as the gasketless flange joints have failed to stand up in service. A new remote water-level indicator has been installed recently to replace one of the two indicators originally provided. This water-level indicator, designed by Professor Loeffler in conjunction with Siemens Halske, consists of a float which transmits its motion by cable over pulleys inside the evaporator to a magnet placed in a communicating pipe. The gage proper is made up of a number of segments arranged one above the other and all pivoted on a common vertical axle. The segment opposite the magnet swings and presents a white portion, while the other segments appear blue. The cable and pulleys within the steam space make it difficult to predict the reliability of this device.

Quite remarkable is the testing and measuring equipment of this installation. The visitor, for instance, can see that for a boiler output of 13,200 lb., the power consumption of both the circulating and the feed pumps is

54 kw. Since about 1,500 kw. could be generated with the above steam output in condensing operation, it figures that the power consumption of the pumps amounts to 3.6 per cent. This ratio, however, obtains for only one particular load, in this case 75 per cent of the boiler capacity. As the power demand of the circulating pump increases with the cube of the boiler output, the pump power demand percentage when operating at full load will be somewhat larger than the above ratio.

The Florisdorf works were just completing a small Loeffler boiler installation for the laboratories of the Vienna Technical University. It is an oil fired unit of only 1,200 lb. per hr. capacity. The space requirements are surprisingly small. The same safety features as in the large boilers are provided. Welding has been used even to a greater extent than on the first boiler. An interesting feature is that the condensation from laboratory heating coils is returned to the boiler by the differential pressure existing between the superheated and saturated steam circuit.

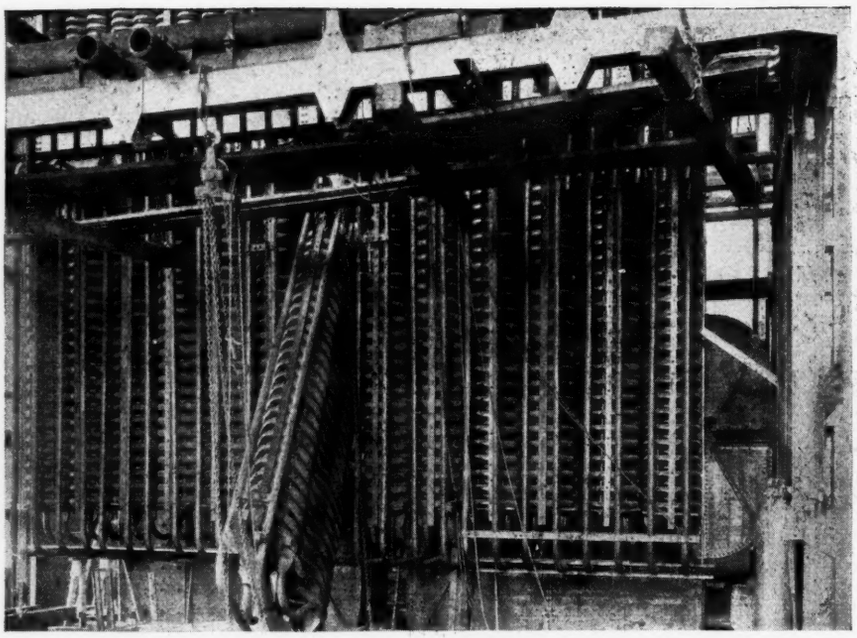


Fig. 4—Convection superheater of Witkowitz boiler being put in place. Radiant superheater manifolds with tube stubs for welding can be seen behind scaffolding

An interesting development is the application of the Loeffler steam generating process to the heating of ovens requiring high temperatures. Experiments carried out at Florisdorf have given satisfactory results and it is expected that this method will soon find its way into industry in serious competition with gas and electrically heated ovens.

Two trips were made to Witkowitz, one, before the conference to see one of the new 100,000-lb. boilers being rushed to completion for the conference, and the other after the conference, to inspect the meanwhile completed boiler. The 40,000-lb. boiler[2] first installed at this plant and placed in operation in July, 1927, differs from the installation at Florisdorf in that it is fired with pulverized fuel and has a differently shaped superheater. Having no reference to the design of the boiler, but of considerable interest is the fact that the furnace walls are cooled with inert flue gas drawn from the stack instead of with air for combustion. No jet flames form at the ports, with the result that the furnace walls last much longer. A separate air preheater takes care of preheating the air for combustion.

The pulverized-fuel firing causes the superheater tubes to reach a higher temperature than those of the Florisdorf boiler, 1,060 deg. F., because of the greater radiant action of the pulverized-fuel flame. It is obvious that such high temperatures would be impossible unless the steam circulation were kept well under control at all times.

The starting time for this boiler is two hours, because steam at only 200 lb. pressure is available for this purpose. The 200-lb. steam, having a very low density, absorbs less heat for the same rate of flow.

The reciprocating circulating pump, which differs somewhat in design from the one at Florisdorf, performs just as satisfactorily as the latter. Its reliability, together with high efficiency, are reasons why a reciprocating pump is being considered for the contemplated 150,000-lb. unit, which will be the final step in "Loefflerizing" the entire steam generating plant of these works.

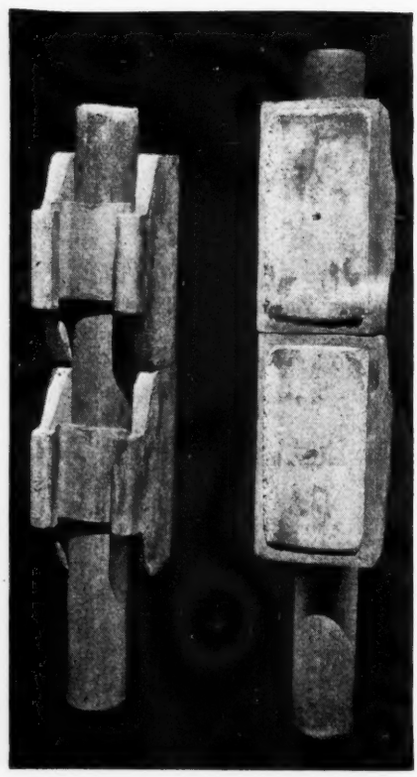


Fig. 5—Superheater tube protecting blocks with wedge shaped spring elements

The recently completed 100,000-lb. boilers each have a centrifugal pump for circulating the steam. They were installed because they produce a steady non-pulsating flow, require less space, and cost but two-fifths of reciprocating pumps. Considerable doubt has been cast upon the practicability of the centrifugal pump for this service, and all kinds of difficulties have been predicted. The packing was usually the center of such comments, although no more of a problem is involved than with the packing of a high-pressure turbine. Usually labyrinth packings are resorted to for this purpose. It was only to comply with the wish of the late inventor that pressure oil packing was adopted instead, in spite of the fact that it adds complications to the recirculating unit. The firm of Escher Wyss, builders of the pump, guaranteed that the losses from the labyrinth packing would not exceed 660 lb. per hour when recirculating 300,000 lb. of steam. Future circulating pumps of the centrifugal type will most probably be equipped with labyrinth packings.

[2]Described in *Power*, March 26, 1929, and in the April, 1929, number of *Mechanical Engineering*.

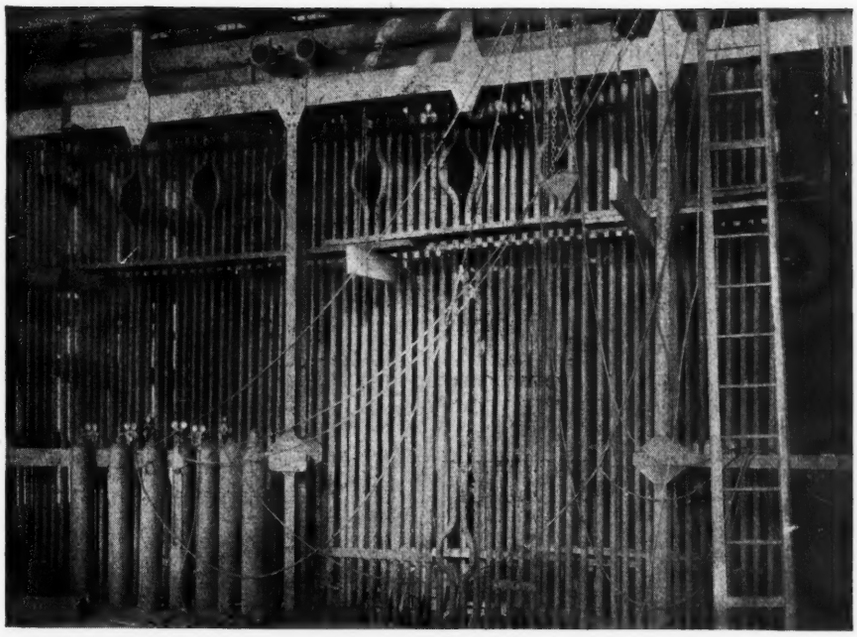


Fig. 6—Front view of Witkowitz boiler after cage type radiant superheater was placed in front of convection superheaters shown in Fig. 4

The use of the centrifugal type circulating pump, however, has brought about new problems. Their nature is understood, however, and it is only a question of how to dispose of them in the simplest manner. The difficulties occur only during the starting period due largely to the fact that only 200-lb. steam is available. Once in operation, the boiler performs up to the mark as was demonstrated to visitors inspecting the plant after the conference.

The positive displacement characteristic of a reciprocating pump is absent in a centrifugal pump, consequently the latter cannot develop the necessary head, with the low-density steam available, to overcome not only the condensation in the tubes accumulated over the shutdown period, but in addition the increased resistance to the flow of low-density steam. The circulating pump, located in front of the boiler,[3] is turbine-driven. Its normal speed is 7,000 r.p.m. For starting purposes its speed is increased to 7,500 r.p.m., and it can develop a maximum of 8,000 r.p.m. The feed pump, alongside the boiler, is motor-driven, running normally at 4,000 r.p.m. and maximum, 5,000 r.p.m.

Another departure from former design is the cage-type radiant superheater surrounding the pulverized-fuel flame from all sides, shown in Fig. 3. The upper part of the superheater tubes toward the rear wall of the furnace and on the sides are protected from the intense radiant action of the pulverized-fuel flame by refractory blocks of novel design. These blocks, Fig. 5, can be readily replaced and a wedge-shaped spring element provides the pressure for a good contact between block and tube.

The tubes toward the boiler front are left unprotected, because it is assumed that the heating will be less intense on this side due to the longer travel of the flame. Whether this will prove to be true remains to be seen. Covering a part of radiant heating surface, according to more recent data, results in a somewhat increased thermal load on the bare tubes. Viewed from another angle, the refractory action of the blocks is beneficial in obtaining high-ignition temperatures at light loads and especially during the starting-up period.

It has been figured out that the tube wall temperature below the protected portion will not exceed 950 deg. F., which is less than that of the radiant superheater of the 40,000-lb. boiler, thus increasing the safety margin by 30 to 40 per cent.

The pulverized-fuel burners, developed in connection with the experimental furnace preceding the layout of the 100,000-lb. boiler, are rather simple in design and emerged as the most efficient from a total of five different types of burners tested. With this burner the pulverized-coal stream is directed against a cone at the mouth of the burner, which imparts to it a flare shape. The flare is intersected by the secondary air stream, the coal stream thus being whipped into turbulence. The high air preheat of over 930 deg. F. contemplated and experimented with for this installation apparently did not prove practical, because only about 500 deg. F. is being used. Such a high preheat as contemplated would have increased combustion temperature 360 deg. F.

Welding has been used throughout, a great deal of it during the erection of the boiler. It is quite impressive to watch the welders at work, and the ease with which they go about welding joints.

Each Loeffler boiler built so far has a steam purifier incorporated in the design. In view of the fact that the steam bubbles travel only a short distance through the water in the evaporator and that the steaming factor (pounds steam per square foot releasing surface) is relatively small, the conclusion was drawn that the amount of moisture entrained by the steam should be negligible. The contention therefore seems plausible that the steam purifier is not required and will be omitted in the future.

The water-level indicators are of the same type as those already described in connection with the Florisdorf unit. Aluminum foil is used for heat insulation of pipes and other metal surfaces, whereas glass wool is used for the other boilers. An interesting observation is that the sheet metal inclosing the insulation is hotter to the touch than other types of insulation, although measurements have proved that the loss is actually smaller. This apparent paradox is explained by the low radiating quality of the sheet-metal inclosure.

Forced and induced draft is used for the new boilers. The pressure drop from furnace to exit air heater is 1.8 in., while the total drop from air intake to gas exit is 4 in. Considering the amount of rather closely arranged tubes, one would expect a greater resistance.

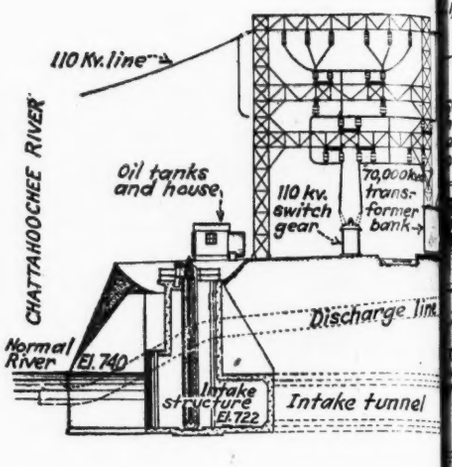
These boilers will eventually be equipped for entire automatic control, but for the time being hand control will be used until the behavior of the boilers is perfectly understood.

As to public opinion on the Loeffler boiler, the indications are that it is gaining favor. With the completion and satisfactory testing of the first Loeffler locomotive for the German government railroad and the fact that during the conference another prominent manufacturer has joined the five others already licensed to build Loeffler boilers, the odds have improved considerably and no doubt we shall see more Loeffler boilers being erected in the near future. It should be said, however, that there are still opponents to the Loeffler idea of generating steam.

[3]See *Power*, May 6, 1930, page 719.

ATKINSON STEAM PLANT

Supplements ATLANTA SYSTEM



By WILLIAM P. HAMMOND and J. M. OLIVER

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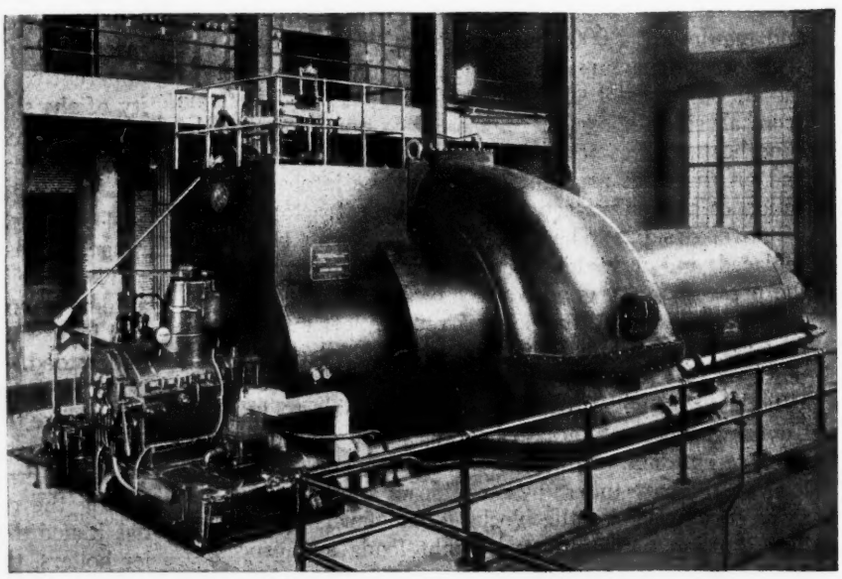
PLANT ATKINSON, the most recent addition to the generating capacity of the Georgia Power Company, is located on the Chattahoochee River near Atlanta. The first unit of this plant, now completed, contains 60,000 kw. of generating capacity.

The plant was not designed as a cheap stand-by plant which would be called into service only in emergency, but represents a plant where efficiency has been weighed against initial investment for the service required over a period of years. In the immediate future it will be called upon for intermittent operation at reasonable load factor to protect the important Georgia load and to supplement power supply from hydro plants during low-water periods, but it will gradually assume its full share of the total system load. As the load continues to grow, additional units will be installed and transmission lines, now being used to bring power into the Atlanta area, will ultimately act as feeders for distributing power from the plant to outlying districts.

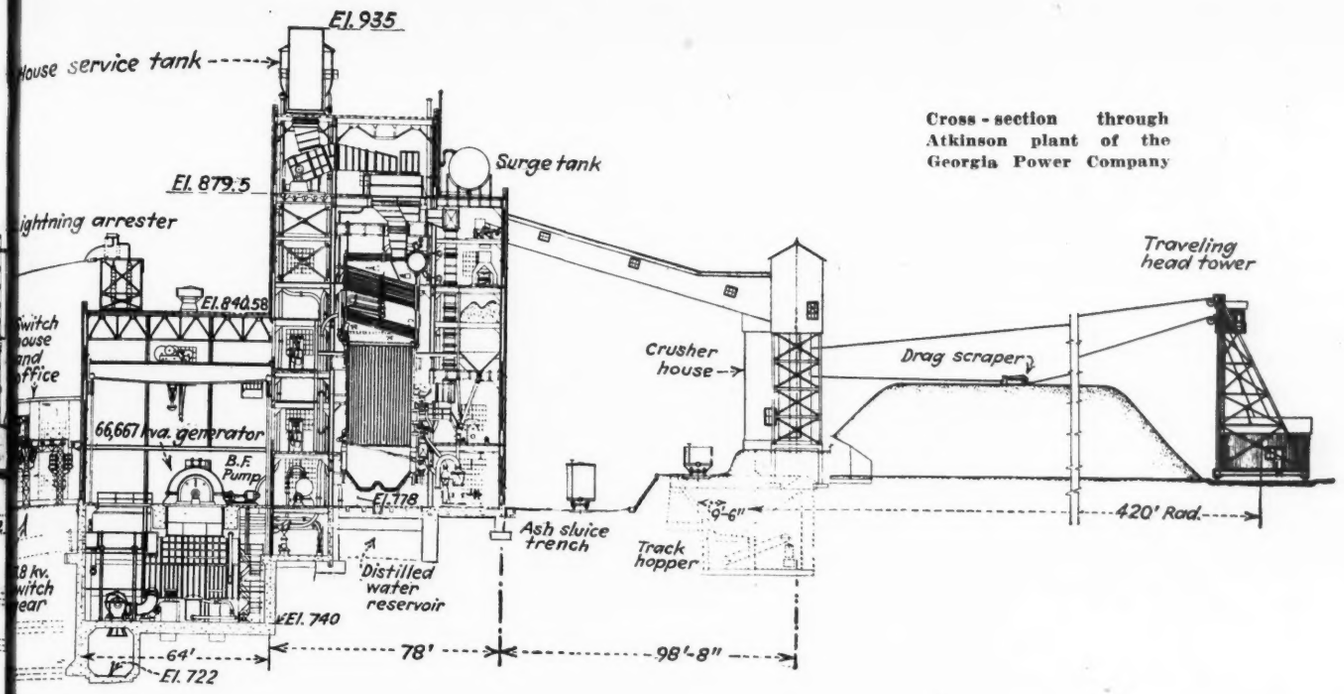
Coal received by rail is dumped into a track hopper from bottom dump cars. The track hopper is built integral with the reclaiming hopper for removing coal from storage. It is also designed to permit the future installation of an automatic car dumper should it later be found desirable. Coal from the track hopper may be delivered direct to the raw coal bunkers in the plant, or to outdoor storage.

Sufficient outdoor storage space is provided for storing 100,000 tons of coal when piled not over 30 ft. high. The coal storing equipment consists of a drag scraper with attendant accessories, having a maximum capacity for handling 200 tons per hour. The head post is located near the reclaiming hopper, but the winding machine and the operator is located in the traveling self-propelled head tower, which takes the place of the tail tower or tail posts common to earlier drag scraper installations.

The coal pile covers 120 degrees of a circle having a radius of 400 ft. The head tower travels on a track ex-



The first unit, of 60,000-kw., is designed for four-stage feed-water heating



Cross-section through Atkinson plant of the Georgia Power Company

tending around the circular edge of the coal pile. Track rails are heavy sections and are placed on 30-ft. gage. The head tower is so designed as not to require rail clamps or outriggers.

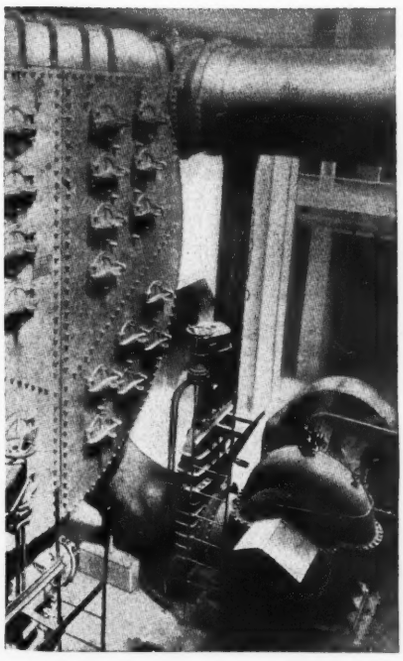
Coal from the track hopper is fed by an apron feeder onto a belt conveyor which transports the coal to the crusher house, delivering it to a crusher of 200-ton capacity. The crusher discharges to either of two conveyors, one delivers coal to storage, and the other elevates it to a transfer tower where a belt conveyor carries it across the tracks into the power-house building. A fifth belt conveyor, equipped with an automatic tripper, distributes the coal to raw coal bunkers.

A magnetic separator removes tramp iron from the coal before it enters the crusher. A weightometer measures the amount of coal delivered to the distributing belt.

Ashes are removed from the boiler room by sluicing. For the present and the immediate future they will be sluiced into the low places around the plant and there used as a permanent fill. Wooden troughs serve as temporary sluicing trenches outdoors.

A cross-section through the plant shows the general arrangement of equipment. The selection of the unit system of pulverized-fuel firing and the subsequent location of the mills and exhausters in the basement of the boiler room effected quite a saving in building cost, compared to various other layouts studied.

There are four pulverizing mills per boiler, each having the capacity to handle six tons of coal per hour. Each mill is equipped with its own feeder and separate coal chute from the raw-coal bunker. The rate of coal supply to each mill is controlled by driving the mill feeders with variable-speed motors, operated from a Ward-Leonard system, which is tied in with the plant combustion control system.



The two-pass surface condenser is provided with an automatic vacuum tripper

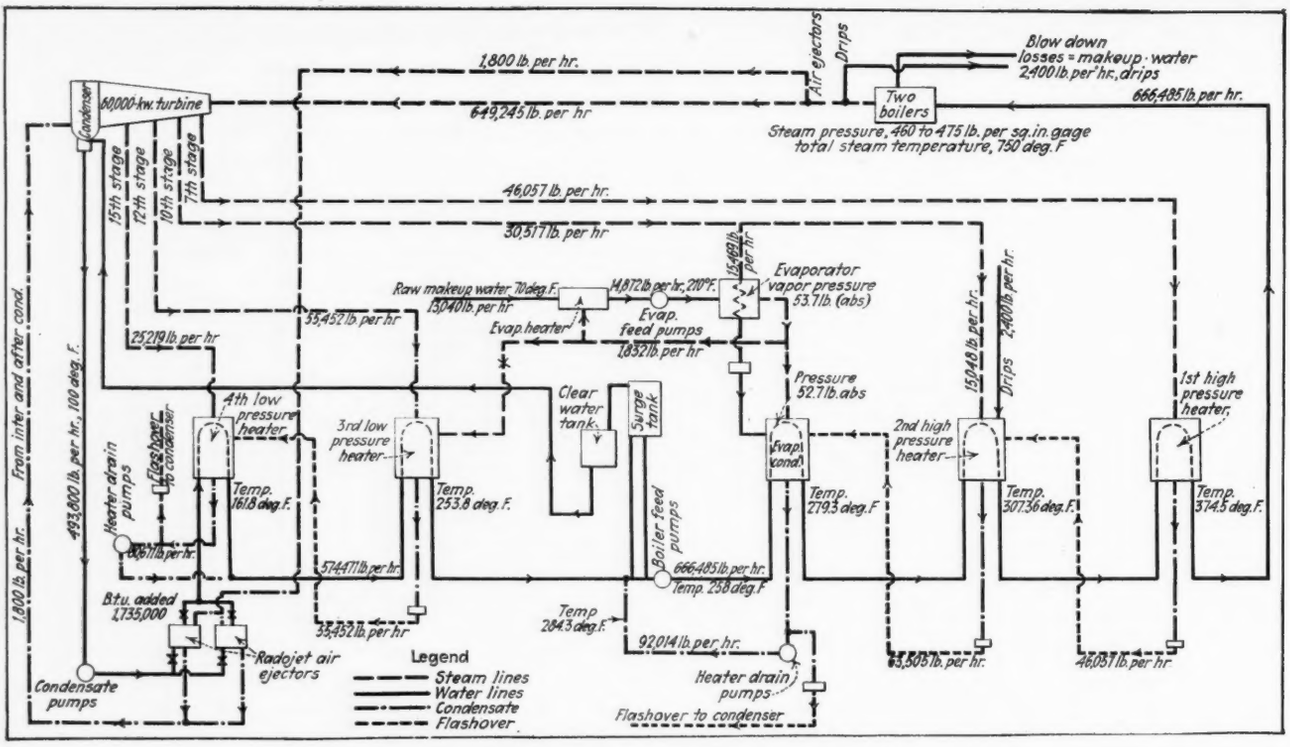
The pulverizing mills are impact type, with the mill exhausters mounted on the same base and driven from the same shaft. Each mill supplies coal to two burners, of which there are eight per boiler. All of the burners are located in the front wall of the furnace.

The two boilers are of the cross drum type, each contain 30,200 sq.ft. of heating surface. They are set singly, and are constructed for a working steam pressure of 475 lb. per sq.in. gage. Each boiler is equipped with an interdeck type superheater to raise the temperature of the steam leaving the boiler to approximately 750 deg. There are two 10-in. steam leads connecting the steam drum to the superheater, one lead entering the superheater header on each side of the boiler. One 14-in. steam line delivers the steam from each superheater to the main steam header, and in each of these main steam leads is installed a flow meter. The maximum rating of each boiler and superheater is 450,000 lb. of steam per hour.

The boiler furnaces are 30 ft. wide, 21 ft. 6 in. deep, and 38 ft. $11\frac{3}{8}$ in. high from the slag screen to the bottom row of boiler tubes. The rear wall and both side walls are water cooled with fin-tube walls consisting of 4-in. tubes spaced on 7-in. centers. The front wall above the burners is of the suspended type and is air-cooled. The heat absorbed from the furnace by the air is not utilized, as studies showed that it could not be done economically.

The water-cooled rear and side walls contribute an additional 3,580 sq.ft. of heating surface to each boiler. The furnace volume is approximately 25,120 cubic feet.

Each boiler is equipped with a revolving-type air pre-



Heat balance diagram showing pressure, temperature and quantities at full load

heater having 30,000 sq.ft. of effective heating surface. The forced- and induced-draft fans are not built in as an integral part of the preheater, but are installed on separate foundations. The preheaters are designed to handle 70 per cent of the air required for combustion and heat it to between 435 and 600 deg. F. for delivery as secondary air to the burners.

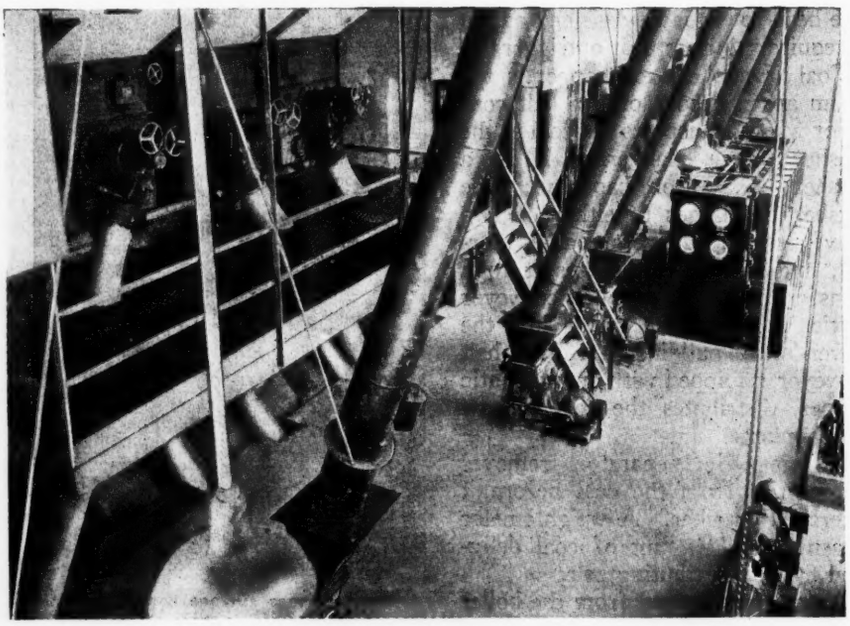
The forced- and induced-draft fans are designed to handle the air and gas when the boilers are operating at their maximum rating of 450,000 lb. of steam per hour per boiler. Selection of driving equipment was made only after a thorough study of several arrangements in an effort to determine the most economical installation. All arrangements studied were based on the use of motors as the driving unit. Turbines were not considered, since exhaust steam from turbine driven auxiliaries could not be advantageously or economically used for feed water heating. The following drive methods were considered:

(a) Variable-speed slip-ring motors, using one motor per fan.

(b) Constant-speed squirrel-cage motors, using two motors per fan, one to drive the fan at light loads and the other to drive the fan at the higher ratings.

(c) Constant-speed squirrel-cage motors, using one motor per fan.

(d) Two motors to drive the induced-draft fans, one motor to be a constant-speed squirrel-cage type to drive the fan at full load, the other motor to be a variable-speed slip-ring type to drive the fan at the lower ratings; the forced-draft fan to be driven by one variable-speed slip-ring motor.



Coal feeders for the pulverizers are located on the boiler room operating floor

(e) One 3-speed pole-changing squirrel-cage motor to drive the induced-draft fan and one 2-speed pole-changing squirrel-cage motor to drive the forced-draft fan.

(f) One 2-speed pole-changing squirrel-cage motor to drive the induced-draft fan and a similar motor to drive the forced-draft fan.

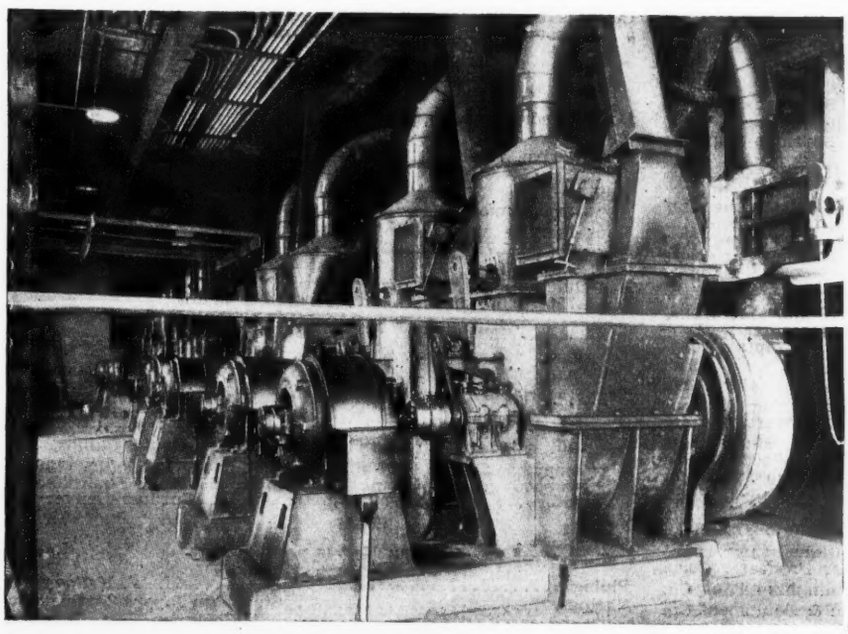
(g) Pole-changing slip-ring motors, one motor to drive each induced-draft fan and one to drive each forced-draft fan.

After analysis of the advantages and disadvantages of the various set-ups, two-speed pole-changing squirrel-cage motors were selected to drive the fans. The pole-changing slip-ring motor drive ran a close second, and

was eliminated only because of the higher first cost and supposedly higher maintenance attendant to such an installation.

Hagan combustion-control equipment is installed for automatic operation of the boiler-room equipment, namely, the induced-draft fan dampers, the forced-draft fan dampers, and the coal feeders. Either or both boilers may also be manually controlled should it become necessary or desirable. CO_2 recorders have not been installed, but provision has been made for their installation at a later date. Under the present arrangement the proper coal-air ratio for most efficient combustion is secured by the manual adjustment of the regulator equipment. When CO_2 recorders are installed it is likely that they will be tied in with the combustion-control equipment in such a manner as to maintain automatically the correct coal-air ratio at all times.

The generating unit consists of a 17-stage, 1,800-r.p.m. turbine connected to a 66,667-kva., 90 per cent power factor, 13,800-volt, 3-phase, 60-cycle generator with a 200-kw., 250-volt, shunt-wound, direct-connected exciter. The unit occupies a space approximately 66-ft. long, 22-ft. wide and 13-ft. high above turbine room floor. The turbine is designed for normal operation with steam at 425-lb. per sq.in. gage pressure, 740 deg. F. and a back pressure equal to 2 in. of mercury. The 7th, 10th, 12th and 15th stages of the turbine are provided with nozzles for extracting steam to various feed-water heaters. The unit is designed for maximum economy when operating at loads between 37,000 and 50,000 kw.



Unit pulverizers of six ton capacity are installed below the boiler operating floor level

The generator air cooler consists of four sections, each containing 4,550 sq.ft. of cooling surface. The generator requires approximately 110,000 cu.ft. of air per minute at full rated load, and this circulation is secured from four blowers, each having capacity to deliver 27,500 cu.ft. of air per minute against a static head of 10½ in. of water. Two fans will be operated at light loads, and three fans in emergency will furnish sufficient ventilation for full load operation.

An interesting feature of the turbine-generator is the absence of an atmospheric relief valve. An automatic vacuum tripper* has been installed in its stead. This consists principally of an enlarged mercury column with a powerful float which operates a pilot for tripping the turbine throttle.

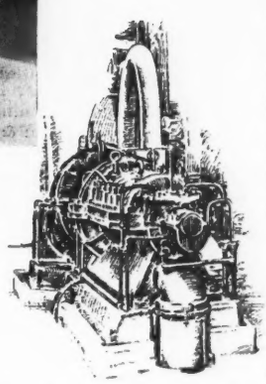
To condense the steam from the turbine a 70,000-sq.ft. two-pass condenser is installed. The condenser contains 12,180 1-in. O.D. Muntz-metal tubes. It has sufficient cooling surface to condense 550,000 lb. of steam per hour, and maintain 2-in. Hg. back pressure, when supplied with circulating water at 82 deg. F. Circulating water is secured from the Chattahoochee River, and is delivered to the condenser by two single-stage centrifugal pumps, each of 57,500-g.p.m. capacity against 20-ft. head.

The intake structure is of concrete design and is located on the river bank approximately 90 ft. from the building. It contains three bays, each to accommodate a traveling screen. Only two revolving screens are installed for the first unit, a third one to be installed when the second unit is added to the plant. A feature of the circulating water system is the use of separate discharge lines from each condenser.

The heat balance diagram shows the expected temperatures, pressures and quantities at full load. Steam for feed-water heating is secured entirely from the four extraction openings provided in the main turbine.

There are four feed-water heaters and one evaporator condenser arranged in series, the evaporator condenser being installed between the two low-pressure heaters and the two high-pressure heaters. Bypasses are provided around all of the heaters so that repairs can be made to any or all heaters while the plant is in operation.

Condensate from the high-pressure heaters is cascaded to the evaporator condenser, from which it is discharged either into the feed-water line on the suction side of the boiler feed pumps or into the main condenser. The drain from the low-pressure heater is cascaded to the lowest-pressure heater, from which it is discharged either into the feed-water line between the two low-pressure heaters or into the main condenser. Traps are installed for draining the individual heaters except where the drain is to be discharged into the feed-water line, in which case single stage centrifugal pumps are used. Only in emergency are the heater drains to be discharged into the main condenser.



In the engineering and design of the electrical features of Plant Atkinson the predominating objectives have been simplicity with an attempt to carefully balance economy against dependability.

*Described in *Power*, Sept. 22, 1925.

This balance shows particularly in the layout of the auxiliary equipment, where provision has been made to operate through one or both of two transformers connected directly to the generator side of the main transformer bus in such manner that the loss of any one piece of equipment will leave the plant in shape to carry from two-thirds to three-fourths of its rated full-load capacity.

Plant Atkinson was designed by the Southeastern Engineering Company, of Birmingham, Ala., and constructed by Empire Construction Company of Atlanta, Ga., these two companies being among those recently absorbed by Allied Engineers, Inc. The design was under direction of O. G. Thurlow, now vice-president, and in charge of the Southern Division of Allied Engineers. Construction work was under the direction of W. C. Cram, Jr., now manager of Allied Engineers' construction forces in the Georgia district. Special acknowledgment is made of the assistance rendered by J. M. Gallalee, consulting engineer of the University of Alabama, and A. T. Hutchins of the Commonwealth & Southern Corporation in designing the plant.

Principal Equipment in Atkinson Plant

Coal Handling and Preparation

Crusher, one, capacity to crush 200 ton per hour to one inch and smaller; drive, 125-hp., 900-r.p.m., 2,200-volt, squirrel-cage motor ..... Pennsylvania Crusher Co.

Apron feeder, one, 200 tons per hour, inclined 12-ft. centers, 4-ft. rise, speed 25 ft. per min., drive 7½-hp., 1,200-r.p.m. 550-volt, squirrel cage ..... Chain Belt Co., Stearns Conveyor Co. Div.

Belt conveyors, five, 36 in. wide, 200 ton per hour capacity, speed 300 ft. per min.; drive, 900-r.p.m., 550-volt, squirrel-cage motor ..... Chain Belt Co., Stearns Conveyor Co. Div.

Weightometer, one, initial capacity 200 tons per hour, 30-in. belt Merrick Scale Mfg. Co.

Storage equipment, drag scraper storing and reclaiming 200 tons per hour ..... Sauerman Brothers

Pulverizing mills, eight impact mills, 6 ton per hour, capacity, 4 mills per boiler; drive, 200-hp., 1,200-r.p.m., 2,200-volt, squirrel-cage motor ..... Combustion Engineering Corp.

Mill exhauster, eight, integral with pulverizer and driven from same shaft ..... Combustion Engineering Corp.

Burners, eight Lopulco type per boiler, Combustion Engineering Corp.

Combustion, control system ..... Hagan Corporation

Ash Handling Equipment

Furnace bottom, two, ventilated, volume each 2,000 cu.ft. Allen Sherman-Hoff Co.

Ash-sluicing equipment, nickel cast-iron sluice liners, nozzles and cover plates ..... Allen Sherman-Hoff Co.

Boilers and Auxiliaries

Boilers, two, sectional cross-drum water-tube, 30,200 sq.ft. heating surface, 488-lb. working pressure, 72-in. drum, 58 ft. 6 in. long, 51 tubes wide, 20 tubes high, 4-in. tubes 24 ft. long Combustion Engineering Corp.

Superheaters, two, final temperature 750 deg. F., interdeck type Superheater Co., Foster-Wheeler Corp.

Furnace, volume, 25,120 cu.ft., water-cooled rear and side walls, fin type, 3,580-sq.ft. heating surface, air-cobled front wall Combustion Engineering Corp., Bigelow-Liptak Corp.

Soot blowers, 22—2-in. elements per boiler Diamond Power Specialty Corp.

Boiler feed regulators, four 5-in. with pressure regulating valves Swartwout Co.

Forced draft fans, two, 150,000 c.f.m. against 14-in. static pressure; drive, 500-hp., 880-590-r.p.m., 2,200-volt, Westinghouse open pole-changing motor ..... Buffalo Forge Co.

Induced draft fans, two, 259,000 c.f.m. against 12-in. static pressure; drive, 750-hp., 880-440-r.p.m., 2,200-volt, Westinghouse pole-changing motor ..... Buffalo Forge Co.

Air preheaters, two, 30,000 sq.ft., Ljungstrom air heater, final temperature of air 450 deg. F. ..... Air Preheater Corp.

Stacks, two, steel, 12-ft. dia., 30 ft. high .... Birmingham Tank Co.

Breeching ..... Southern Iron & Equipment Co.

Turbine Generator and Auxiliaries

Turbine, 60,000 kw., 1,800 r.p.m., 17 stages; extraction from 7th, 10th, 12th and 15th stages; generator, 66,667 kva., 13,800 volt, 3 phase, 60 cycle; exciter 200 kw., 250 volt shuntwound General Electric Co.

Auxiliary exciter, 200-kw., 250-volt, shuntwound generator; 300-hp., 2,200-volt, 1,750-r.p.m., 3-phase, 60-cycle, squirrel-cage motor ..... Westinghouse Elec. & Mfg. Co.

Generator air cooler, two-pass, fin-tube cooler, four sections, 18,250 sq.ft.; four fans, each 27,500-c.f.m. capacity against 10.5-in. static pressure; drive, 100-hp., 2,200-volt, 1,200-r.p.m., squirrel-cage motor ..... General Electric Co.

Air cooler duct work ..... Southern Iron & Equipment Co.

Turbine oil cooler, one, two-pass, 597-sq.ft. surface Andale Engineering Co.

Turbine oil purification, continuous bypass filter 4,000-gal., 2-compartment, precipitation tank ..... S. F. Bowser & Co.

Condenser and Auxiliaries

Condenser, 70,000-sq.ft., two-pass; 12,180 tubes, 1-in. dia., Muntz metal ..... C. H. Wheeler Mfg. Co.

Circulating pumps, two, 43,000 g.p.m., single-stage, 20-ft. head; drive, 300-hp., 257-r.p.m., 2,200-volt, squirrel-cage motor C. H. Wheeler Mfg. Co.

Condensate pumps, two, 1,210 g.p.m. two-stage, 215-ft. head; drive, 125-hp., 1,200-r.p.m., 2,200-volt, squirrel-cage motor C. H. Wheeler Mfg. Co.

Air ejector, two, Radojet air pumps, two-stage, enter and after condensers ..... C. H. Wheeler Mfg. Co.

Traveling water screens, two, Rex traveling screens, 62,000-g.p.m. capacity at 2.7 ft. per second water velocity .... Chain Belt Co.

Feed Water Equipment

Feed water heaters, four, vertical, closed-type, two-pass; two are high-pressure with 2,540 sq.ft. surface; two are low pressure with 2,600 sq.ft. surface; maximum temperature, 386.5 Deg. F. Croll-Reynolds Engineering Corp.

Evaporators, two, single-effect units, 600 sq.ft. surface in each; capacity of system, 24,000 lb. water per hour Foster Wheeler Corp.

Evaporator feed heater, one cast-iron plate type, capacity to heat 24,000 lb. per hour from 70 to 210 deg. F. .... Cochrane Corp.

Evaporator condenser, one vertical, closed, two-pass, floating head, 2,540 sq.ft. surface .... Croll-Reynolds Engineering Corp.

Condensate traps, three 125-lb. multiport drainers; four 250-lb. pressure drainers ..... Cochrane Corp.

Pumps and Compressors

Boiler feed pumps, two, 1,600-g.p.m., 6-stage, 1,235-ft. head Dean Hill Pump Co.

Motor drive, 750-hp., 1,800-r.p.m., 2,200-volt, squirrel-cage Westinghouse Electric & Mfg. Co.

Turbine drive, 775-hp., 1,750-r.p.m., single-stage, 425-lb., 750-deg. steam, atmospheric exhaust. Westinghouse Electric & Mfg. Co.

House service pumps, two, 1,000 g.p.m., 227-ft. total head; drive 100-hp., 1,750-r.p.m., 2,200-volt, squirrel-cage motor A. S. Cameron Steam Pump Works

Ash sluicing pumps, two, 1,500 g.p.m., 327-ft. head; drive, 200-hp., 1,750-r.p.m., 2,200-volt, squirrel-cage motor (Cameron) Ingersoll Rand Co.

Heater drain pumps, one, 275 g.p.m., 215-ft. head; 20-hp., 1,750-r.p.m. motor; one, 175 g.p.m., 235-ft. head; 25-hp., 1,750-r.p.m. motor ..... (Cameron) Ingersoll Rand Co.

Evaporator feed pump, two 60 g.p.m., 127-ft. head; 7½-hp. motor Dean Hill Pump Co.

Sump pumps, one, 300 g.p.m., 60-ft. head; one, 80 g.p.m., 55-ft. head ..... Dean Hill Pump Co., Gould Pumps, Inc.

Air compressor, one, 9½x6-in., vertical duplex, 198 c.f.m., 100-lb. pressure; drive, 50-hp., 1,200-r.p.m., 550-volt, squirrel-cage motor ..... Gardner-Denver Co.

Piping Valves and Fittings

Piping ..... M. W. Kellogg Co.
Fittings ..... Stockham Pipe & Fittings Co.
Gate and check valves ..... Chapman Valve Mfg. Co.
High-pressure globe valves ..... Edward Valve & Mfg. Co.
Intermediate-pressure globe valves ..... Lunkenheimer Co.
Low-pressure globe valves ..... Wm. Powell Co.
Boiler non-return valves ..... Schutte & Koerting Co.
Boiler blow-off ..... Crane Co.
Pressure reducing valves ..... Fisher Governor Co.
Safety valves ..... Consolidated-Ashcroft-Hancock Co.
Circulating, water-motor operated ..... Chapman Valve Mfg. Co.
Twin strainers ..... Andale Engineering Co.
Priming ejector ..... Schutte & Koerting Co.

Instruments

Recording thermometers ..... Bristol Co.
Indicating thermometers ..... C. J. Tagliabue Mfg. Co.
Recording and indicating pressure gages. C. J. Tagliabue Mfg. Co.
Mercury columns ..... Consolidated-Ashcroft-Hancock Co.
Conductivity meters ..... Esterline-Angus Co.
Venturi meters ..... Builders Iron Foundry
Steam flow meters ..... Brown Instrument Co.
Water meters ..... Worthington Pump & Machinery Corp.
Draft gages ..... Ellison Draft Gage Co.
CO_2 machine ..... Hays Corp.
Pyrometer, recording ..... Leeds & Northrup Co.

Balanced-Torque Speed Matcher Make Synchronizing Automatic

By J. H. ASHBAUGH

Control Engineering Dept.,
Westinghouse Electric & Mfg. Co.

THERE are many places where it is necessary or desirable to automatically make one machine follow another machine in speed relation. One such application is when synchronizing. If the incoming machine is to be synchronized automatically then it is essential to automatically match its speed with that of the system.

A speed matcher for such installations must not only be accurate but it must have incorporated in it means to prevent surging of the machine. The balanced-torque type speed matcher is a device which is simple in construction and operation and is designed for this particular application.

The machine derives its name from the fact that a torque is produced proportional to the speed of the incoming machine and the line frequency. The two torques are balanced against each other. When they are in perfect balance the speed matcher is in equilibrium but when one or the other varies, due to speed variation, the balance is upset and closes a contact. The time of engagement of this contact is proportional to the speed variation, therefore the correction which is made to return the speed to normal is proportional to the need for such correction.

The torque is obtained from small flyballs *F*, Fig. 1, which are driven by a synchronous motor *S*, deriving its power from the machine to be regulated. The ball thrust bearing *B* transmits the torque produced to the lever *L*. The motor *S'* is driven from the other machine to be matched on the line if synchronizing. This motor drives fly balls *F'*. The centrifugal force will increase with increasing speed and frequency. The centrifugal devices are adjusted to exert the same upward force on lever *L* when the frequencies of the two sources to which the motors are connected are equal and thus lever *L* will be horizontal. If the frequency or speed of one of the power sources is varied, for example, the source to which motor *S* is connected, lever *L* will move away from its balanced horizontal position. Contacts *C*, attached to lever *L*, will then move up or down dependent upon whether the frequency of motor *S* is increasing or decreasing. The movement of contacts *C* and consequently their position will depend on the amount the frequency or speed deviates.

Upper and lower contacts *C'* are made to oscillate up and down by the cams *O* and *O'* which are driven by a constant-speed motor *M*. In this manner when contact *C* deflects, the time of its engagement with either the upper or the lower contact *C'* is a function of the amount of this deflection and is proportional to the deviation from normal in the unit being controlled.

Contacts *C* and *C'* control small auxiliary contactors. These contactors in turn control the governor-mechanism motor of the prime mover and in this manner correct for the speed difference between the two sources whose speeds are to be matched.

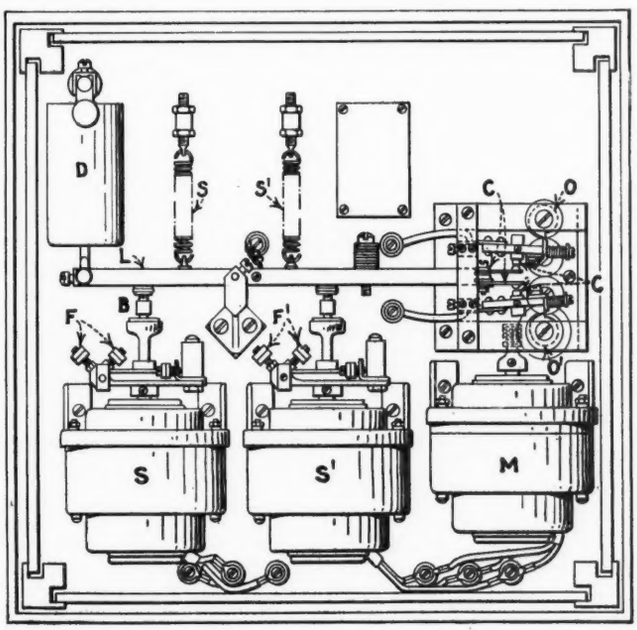


Fig. 1—Diagram of speed matching equipment

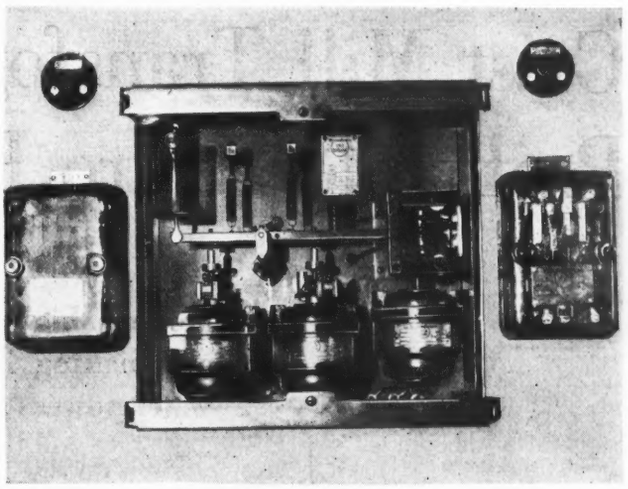
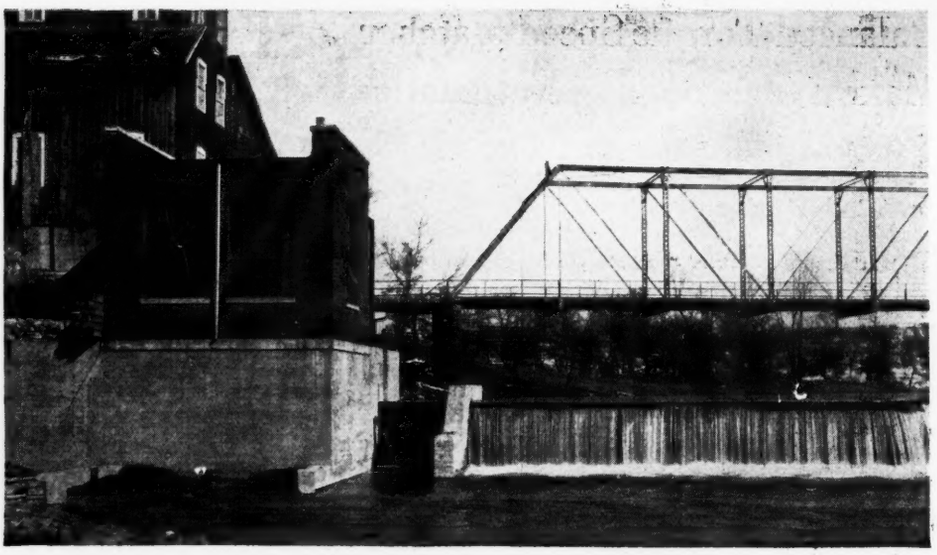


Fig. 2—Speed matcher for automatically controlling the speed of two machines

The dash pot *D* is of the graphite-piston type using air as a damping medium. This type of damping device was chosen because of its reliability and simplicity. Its only purpose is to stabilize the lever system. The sensitivity of the device can be adjusted by the springs *S* and *S'* above lever *L* and the zone of insensitivity can be made any desired value by opening or closing contacts *C*, so that they will remain closed for a shorter or longer time as may be required.

When the speed matcher is operating, the length of time the corrective impulse is given the governor motor depends upon the need for correction. Thus if the speed has varied a minute amount a very small impulse is given for a short duration of time. The speed and design of cams *O* and *O'* determine this feature. The device is capable of running the governor motor continuously if the speed deviation is large. This feature insures quick acting, and a speed matcher that does not continuously surge the regulated machine up and down. Fig. 2 shows the device mounted on its base and inclosed in a front-hinged plate-glass case. The driving motors and other parts can be easily identified by comparing them with those in Fig. 1.



Left foreground, new plant with old grist mill in the rear

Grist Mill Transformed to Profitable Hydro Plant

Modern high-speed wheels and automatic control are making it profitable to develop many small water powers that would otherwise be uneconomical

By LAWRENCE H. JACOBSON
Consulting Engineer
Minneapolis, Minn.

A PERIOD has been reached in water power where much re-development is being done; more will be made in the future to realize the full value of these resources. Three major points to which attention must be given when re-developing old water powers, if they are to be made financially successful, are proper construction, equipment suited to the stream, and automatic control. That all phases of construction may be carried out properly, an engineer should be selected who has had experience in the hydro-electric field.

Often it is possible to use the old dam in a re-development after making repairs. Existing flumes, if in good condition and of proper size, and other parts of old structures can sometimes be used. These features must be carefully considered in order that cost may be held at a minimum. Reconstruction of small water powers cannot be made elaborate, as they will generally not stand as large an investment per unit capacity as will a large development. A small plant can be designed to have a neat appearance without excessive cost. An experienced engineer is in a position to carefully analyze existing conditions and make a close estimate of the cost, so that the owner can determine the advisability of embarking on a program of re-development, and, if the re-development is made, supervise its construction.

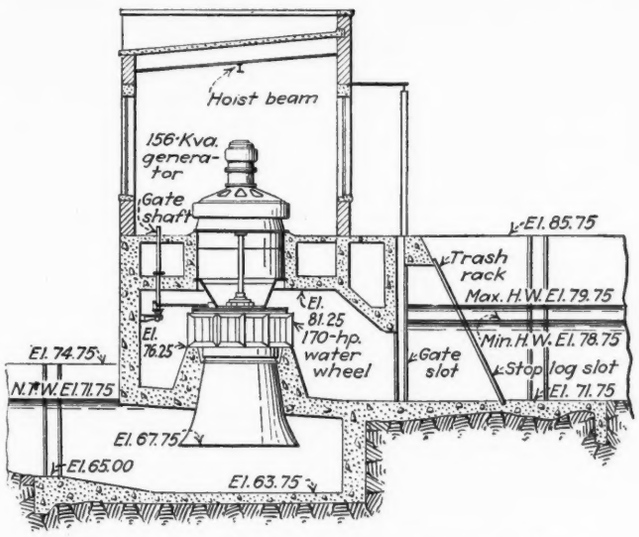
Many waterwheels installed in the older mill developments were constructed by rule-of-thumb methods, and in many instances have been found to be only about half as efficient as equipment designed and installed in recent years. Modern vertical-type waterwheels with direct-connected generators give over-all efficiencies as high as 83 per cent for small units.

The advent of high-speed or propeller-type waterwheels in vacuum-type settings has made possible the development of low-head water powers heretofore thought impracticable. This type of wheel will deliver power at good efficiency and maintain its speed under extremely low heads and under a wide variation in head. Many plants with old-type waterwheels installed under a low head have found it necessary to shut down for days at a time during flood periods. The new equipment offers new possibilities for low-head developments, because it permits of their successful operation nearly 100 per cent of the time. This fact should give encourage-

ment to owners of the older types of low-head developments.

Automatic switching and control apparatus is also making practicable the development of small power sites and the re-development of existing small plants. This equipment, which is now being manufactured at a nominal cost, eliminates the necessity of an operator in the plant, only occasional inspection being required. In many instances automatic control will make an otherwise unprofitable development financially successful. The control may be full automatic to start and stop the unit by a float switch or according to the demand for current, or the plant may be operated by remote control from a distant point, such as the owner's office or from a distant power station. An indicator can be installed at the distant point so the operator will know at all times just what the plant is doing.

As a typical installation, that of the Neshonoc Light & Power Company near West Salem, Wis., may be cited. This company owned an existing development on the La Crosse River, and a small grist mill about five miles downstream which was being driven by two old waterwheels with power transmitted through gears and belts. There was an old wood dam, and about 7 to 8 ft. head was available. The headpiece shows the new power plant with the old grist mill in the background, and the photographs on this page are interior views of the plant. This installation includes a 170-hp., 138½-r.p.m. James Leffel & Company high-speed waterwheel, mounted in a vacuum-type flume with a steel-plate draft tube. The wheel is controlled by a Woodward governor, and drives a 156-kva., 2,300-volt, Electric Machinery Manufacturing Company generator, which is controlled by Pearson automatic-control equipment.

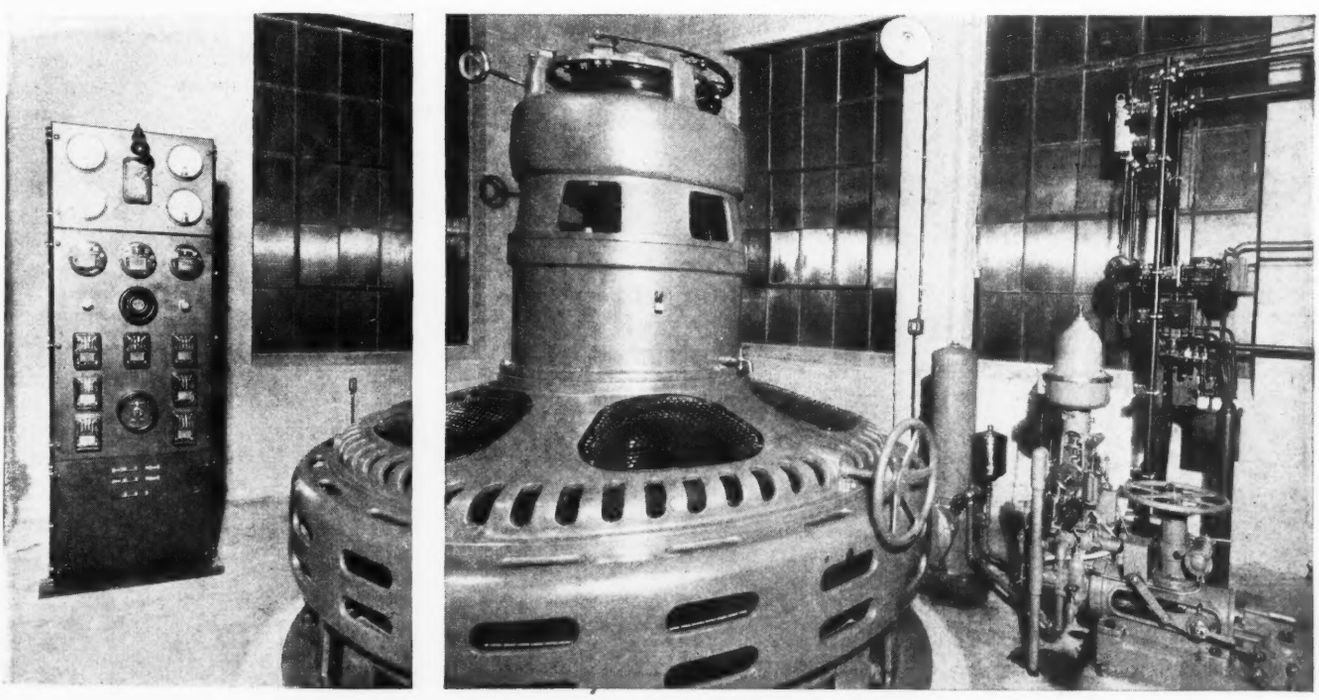


Waterwheel is installed in a vacuum-type setting to provide space for a suitable draft tube

Two control wires run between the two plants and serve to start and stop the unit in the new plant and operate an indicator in the old plant, so that the operator in the latter knows at all times the operating conditions at the former. When the switch is thrown at the upper plant, the governor opens the gates, starting the wheel and generator. After the proper generator voltage is built up, automatic speed matching and synchronizing equipment is put in operation to match the frequency of the generator with that of the power system. Then the automatic synchronizer closes the switch connecting the generator with the power system at the proper phase relation.

The cross-section of the plant shows the setting of the wheel and general outline of the plant. The vacuum-type flume causes the water to rise in the flume to a higher point than the normal head water in the forebay. This permits of setting the wheel sufficiently high to install a suitable draft tube, and also prevents the wheel from drawing air, as sometimes occurs in an open flume.

The plant is simple in construction and operation and is proving itself a worthwhile investment. It is the writer's belief that there are many similar re-developments to be made which will likewise prove profitable.



On the left is the panelboard and on the right the governor for automatically controlling the generator and waterwheel

George Westinghouse Enshrined at Schenley Park

LAST WEEK, in Pittsburgh's beautiful Schenley Park, the spirit of George Westinghouse returned as a shining light to warm the hearts of a great throng assembled to do him honor. Fifty-four thousand employees of industries created by this industrial pioneer and leader of men had expressed their devotion by individual gifts. And these gifts had crystallized into a memorial of surpassing beauty and significance.

For the unveiling ceremony, Oct. 6, eight hundred people, including prominent figures in America's engineering, industrial and financial worlds, gathered in a wooded ravine, where the clear sunshine of a perfect day tinted the foliage of early autumn.

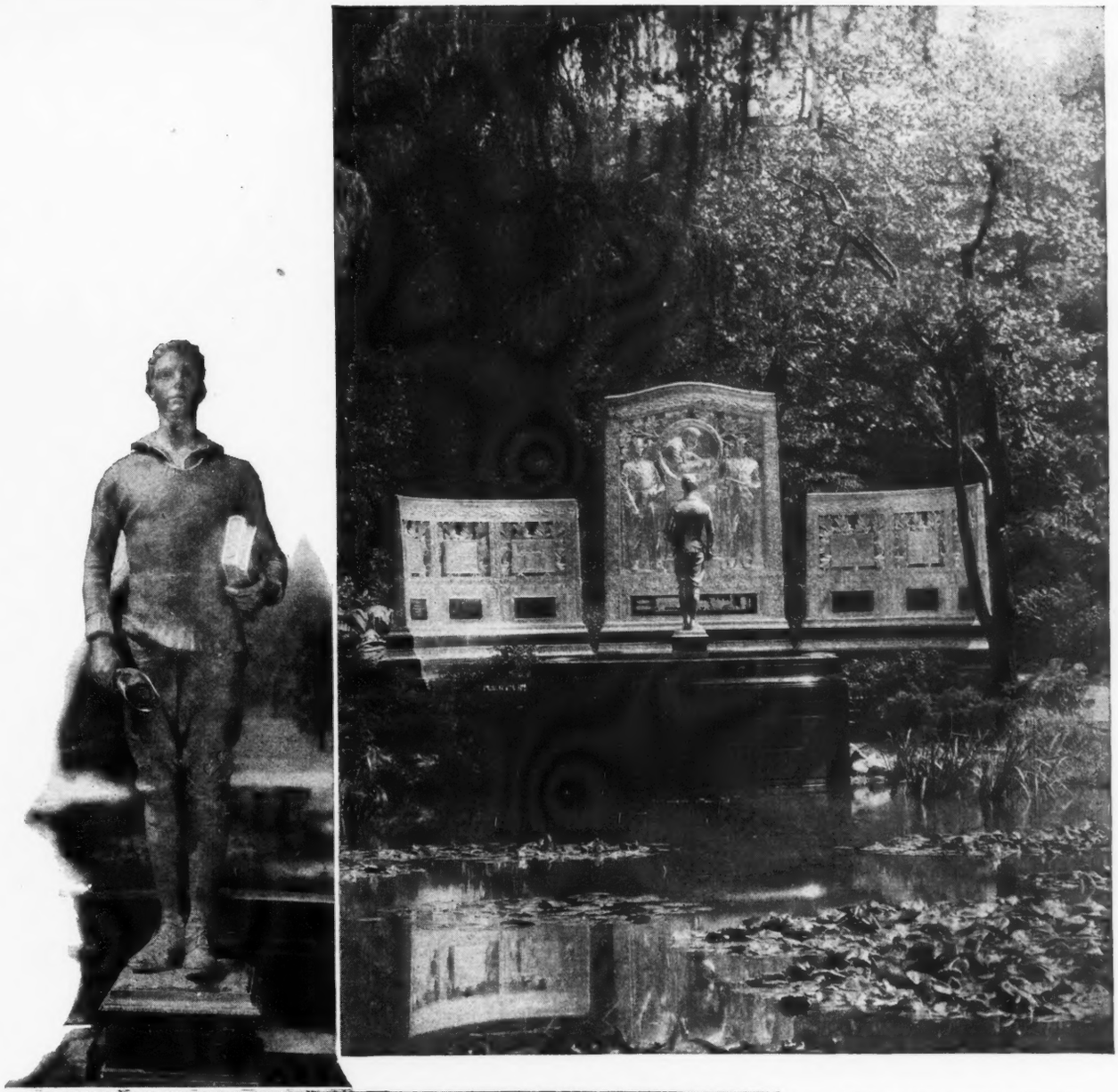
There, in bronze, was revealed American Youth, head erect and eyes fixed in inspired contemplation of a medallion of George Westinghouse—bent low over his drawing board. Fittingly standing beside Westinghouse, a skilled mechanic on one side, and an engineer on the other, symbolized the human agencies through which the master's genius has been transmuted into universal service.

Bronze wings, flanking the main panel, recorded outstanding achievements of Westinghouse; the introduction of alternating current in 1893, the first hydro-electric plant at Niagara Falls, alternating-current railroad electrification, the introduction of the steam turbine to American engineers, the air brake and railroad switching and signalling systems. In these and other fields Westinghouse patented more than 400 inventions.

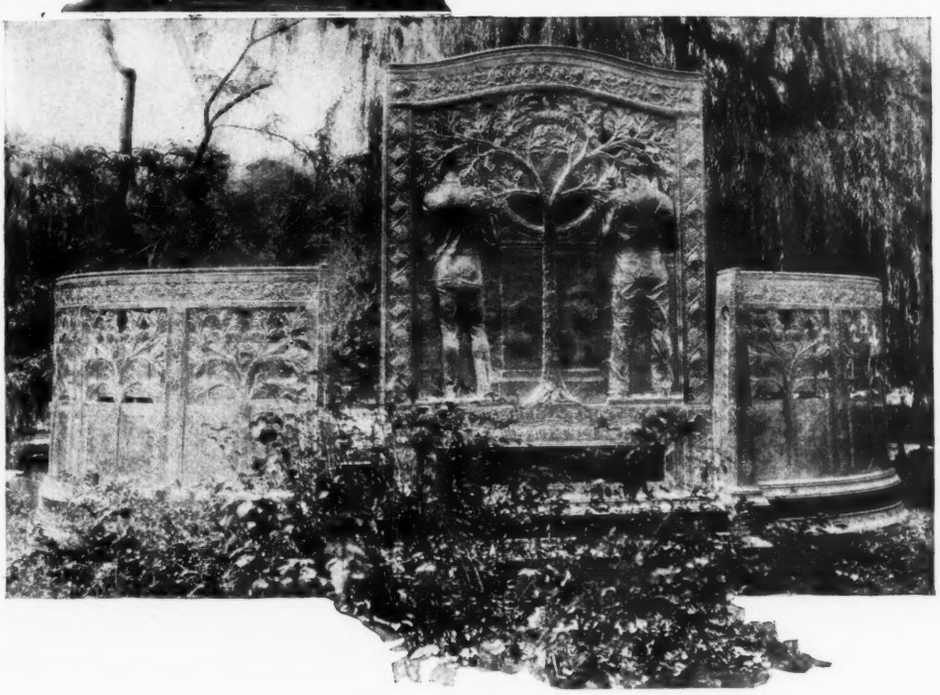
Here was a memorial worthy of its subject in a setting equally worthy—a perfect picture, framed in arching willows. In the foreground a lily pond reflecting the gleaming gold leaf of the memorial.

At the dedication, and later at a banquet of 700 guests, the epic story of George Westinghouse was told by distinguished speakers. In the tributes of A. W. Robertson and A. L. Humphrey, Westinghouse executives, and in those of Bishop Mann, Lord Southboro and others, he was revealed as a man of creative imagination, of steadfast vision, of iron will and ability to carry men forward to his great purposes.

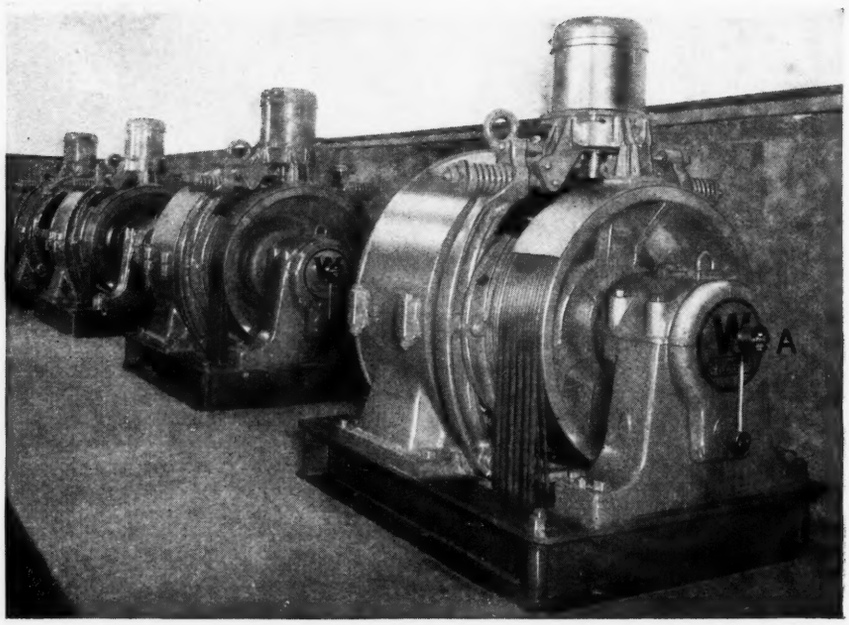
Side view of memorial. Henry Hornbostel, noted architect and designer of the memorial, is in this photograph



Front view of the memorial, and a ten-foot figure representative of American Youth, the latter a sculptural triumph of Daniel Chester French



Rear of the memorial. In the center panel can be seen the backs of the engineer and mechanic that are on either side of Mr. Westinghouse on the front of the panel



The elevator machines are of the full-wrap traction type. A mileage recorder *A* is connected to each machine

MAKING ELEVATOR SERVICE AUTOMATIC

In the News Building, New York City, the elevators respond automatically to push-button control and are automatically scheduled. The cars' positions in the hoistways and the location of waiting passengers on the floors are automatically indicated to the starter

DURING RECENT YEARS the trend in elevator control has been toward automatic operation. Not only is this true of the elevator machines but also of the auxiliary equipment. The elevators in the new 36-story News Building, 220 E. 42d St., New York City, are an excellent example of a modern installation. Not only are the cars automatically controlled from push buttons, but an automatic scheduling system, a car-position indicator and a telltale annunciator are installed. Everything has been included in the equipment to provide efficient elevator service with a minimum of human supervision.

In Table I are listed the elevators in the building. The 13 passenger cars and the service car are controlled automatically. The high-rise express cars listed in the table, although operated at 700 ft. per min. to meet New York City Code requirements, are designed for 800 ft. per min. The service elevator normally operating at 600 ft. per min. can be adjusted for slow-speed safe-lifting capacity of 5,000 pounds.

All the elevators were built by the Westinghouse Electric Elevator Company. The service and the passenger machines are equipped with this company's automatic inductor-type control. With this control system, the cars automatically stop level with the floors in response to buttons pushed in the car by the operator, or by passengers on the floors. Fig. 1 is the control panel in one of the cars. The control buttons *C* correspond to the floors that the elevator serves.

Assume that the car is at the bottom landing. As the passengers come in and call their floors the operator pushes buttons corresponding to the floor numbers called. When the operator receives the signal to start he moves the small control switch *L* to the position to close the doors. When the power operated doors close, the car starts automatically and proceeds up the hoistway at full speed until it approaches the first floor for which an up button has been pushed, either on the car or in a corridor. As the car comes into the stopping zone of this floor it will slow down, stop level with the landing and the doors open automatically. After the passengers get on or off the car, the operator moves the control lever to the closed position the doors close, and the car proceeds up the hoistway, stopping at the floors automatically for which buttons have been pressed.

From the foregoing it will be seen that the only part that the attendant performs in operating the car is to close the doors by moving a small lever and press buttons corresponding to the passenger's floor calls. When a waiting passenger presses a button in a corridor to go either up or down the first car approaching the landing will stop, and the doors open automatically. In this operation, nothing is left to the operator, the car stops at the request of the passenger, therefore, there can be no complaint of the operator passing the floor without stopping.

At the top landing, the car control is reversed automatically, and all the buttons released ready for use by

the operator to register the passengers floor calls in the down direction. When the operator closes the doors at the top landing the car starts down and answers the calls in that direction. At the lower landing the control is reversed and the buttons released for up direction operation.

Should a car have a full load of passengers, the operator may bypass the landing calls by throwing the switch *P* to the off position. The landing calls bypassed are transferred to the next following car. Bypassing the floor calls does not interfere with the calls on the car buttons.

The door lever *L* has three positions, which give the operator complete control of the doors at the landings while the car is not in motion. When the control lever is moved to the closed position the doors start to shut, but if the lever is moved to the neutral position, they will immediately reverse and return to the open position. When the lever is moved to the other position, the doors will close, but the car will not start, since the doors' interlock circuit is open. This position of the control level allows operating the doors to test their movement without starting the car.

If for any reason the operator desires to stop the car when it is in motion, this may be done by pressing the stop button *S*. When the car has been stopped by pressing button *S* it will not start again until reset switch *F* has been closed. Should it be necessary to reverse the car at any position in the hoistway, this may be done by pressing the opposite terminal button. For example, if the car were going in the up direction and the operator pressed the first-floor button, the car would immediately slow down, stop and accelerate in the opposite direction. If the car is not stopped by call buttons being pressed, it will return to the first-floor terminal. If the car, while traveling in one direction, stops at an intermediate floor, and the opposite terminal-landing button is pressed, when the doors are closed, the car will start in the reverse direction.

Lever *L'* is for emergency control of the car and will operate it at about 100 ft. per min. This lever is for operating the machine during inspection and maintenance or at other times when it is desired to run the car at slow speed. The switch *E* allows changing from automatic to hand control or vice versa. With the switch thrown to the up position the car is on hand control from lever *L'*. Throwing switch *E* to the other position puts the car under automatic push-button control.

Switch *D* is the cutout for the interlocks on the landing and the car doors. These interlock cutouts are under glass and can only be operated by breaking the glass as in a fire alarm box. By breaking the glass in one box the operator can throw a switch that allows operating the car without the landing door interlocks in service. Breaking the glass in the other box allows cutting the car door interlocks out of service. Should the interlock circuits become open, the car would not start when the car doors close. By operating the emergency switch, the interlocks are cut out and the car operated temporarily until the fault can be corrected.

At the bottom of the panel, switch *M* is for starting and stopping the motor-generator set that supplies power to the elevator motor. At the right of this switch is a light that shows whether the machine is in operation. In the lower right-hand corner of the control panel are two switches, one for starting and stopping the fan in the car and the other for control of the lights.

On the top of the control panel, the two lights *A* and *B* are on the call-indicator system. One of the lights indicates calls on the floors above the car and the other calls below the car and are marked respectively, "Calls Above" and "Calls Below." This system is used for night service and during rush hours in the day time. Switch *P'* cuts the call-indicator system in or out of service. In ordinary night service the car will be parked at the lower terminal landing with the call indicator system cut into service. If a call button is pressed on an upper floor a buzzer rings and calls the attendant's atten-

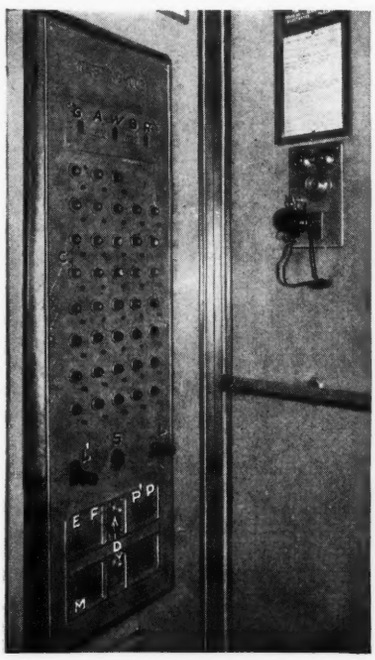


Fig. 1—Push-button control and signal panel in the service car that serves all floors

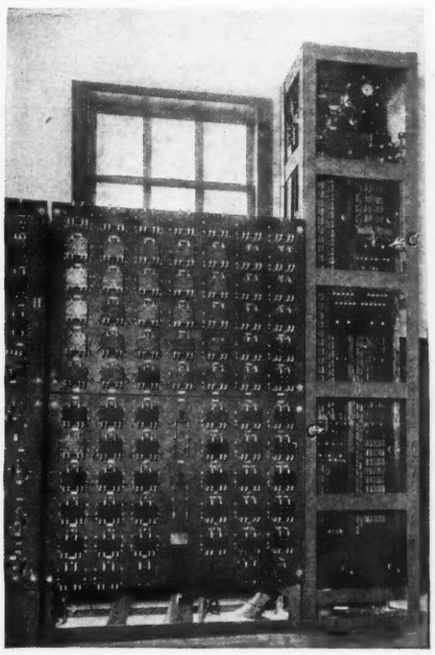


Fig. 2—Part of the service-car control and relay panel, with the floor-selector switch on the right

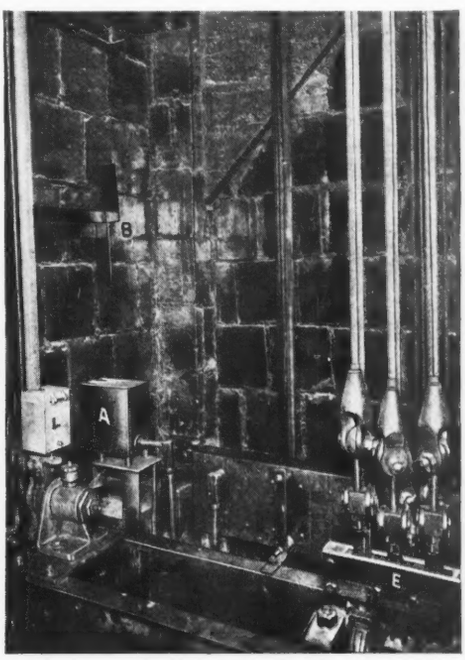


Fig. 3—Top of car, showing inductor relays *A*, inductor plates *B*, cable equalizer *E* and guide-rail lubricator *L*

tion, who starts the car in the up direction. If there are up-direction calls, the car will go to the first floor called and stop automatically and the doors open. If the calls are for down direction only the car will continue in the up direction. When it is above the floors from which the calls were made, the call-above signal goes dark and the call-below signal lights. This shows the operator that the floors where the calls were made have been passed. The operator then presses the first-floor terminal landing button, and the car reverses and automatically answers the down calls. If there were several up calls to be answered when the car started upward, either from floor or car buttons, these would be taken care of in the usual way. When these calls are answered and the car is above the highest down call, as shown by the call-below light, the operator by pressing the first-floor landing button reverses the car and answers the down calls.

Fig. 4—Bank of control panels for the high-rise express cars

During rush hours in the up direction the operator may use the call-indicator to show if there are calls above where the last of the car's passengers are discharged. If they are not, the first-floor landing button may be pressed and the car returned immediately to the lower terminal.

The three lights, *G, R* and *W,* at the top of the panel are on the automatic-scheduling system, Fig. 5. With this system the dispatcher is relieved of all responsibility for starting the cars at given intervals. The dispatcher adjusts the scheduling machine to signal the cars to start at the desired intervals, after which this operation is taken care of automatically. If there are five cars in the bank and the round trip time is 175 sec. the scheduling machine would be set to start the cars at 35-sec. intervals. At the first floor terminal landing a green light flashes in the car to indicate to the operator when to start. When it is time for the car to leave the top door a red light flashes and when the car should be halfway down the hoistway a white signal is given. Thus the cars are not only scheduled automatically, but the operators are given signals to show them whether they are running on schedule. In this way the cars are kept equally spaced in the hoistway, and a uniform elevator service maintained. One of the causes of complaint against elevator service is that it is not uniform at the intermediate floors. Some times the cars pass too frequently and at others the intervals between cars is too long. By automatically scheduling the cars a more uniform service is maintained.

In the rush hours the schedule system can be arranged to allow a longer time for the car to travel in one direction than in the other. In the morning when the traffic is practically all in the up direction, a longer time can be allowed for the up travel than for the down. When the down traffic is heavy a longer period can be allowed for the down trip than for the up. All the time the operators know how closely they are running to schedule.

When the rush periods are over and a car is taken out of service, the automatic-scheduling system can be easily and quickly adjusted to the new conditions.

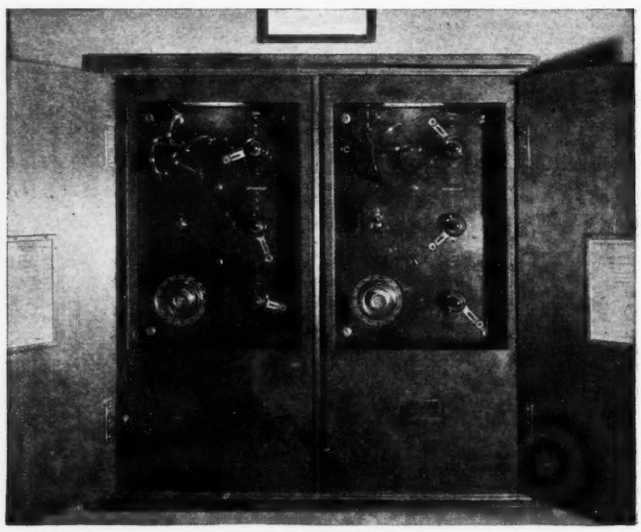


FIG. 5—TWO OF THE THREE AUTOMATIC SCHEDULING MACHINES

Each bank of elevators has its automatic scheduling machine that signals the operators when to start the car at the terminal landings and when the car should be halfway down the hoistway.

No matter how conscientious operators may be, conditions arise that prevent them from keeping the cars on schedule. One car coming down may have to answer calls on every floor, where the following car may not have any. This tends to cause the following car to run up on the other. Then again operators may loaf and try to place their failure to run on schedule to other causes. To take care of these conditions the dispatcher is provided with a car-position indicator and a telltale annunciator. The position indicator shows the location of each car in the hoistway, thus indicating how closely they are running to schedule. The tell-tale annunciator shows the floor calls. If the dispatcher sees that a car is having an unusual number of calls to answer and is falling behind schedule, by closing a switch the floor calls can be bypassed to the following car. In this way the dispatcher has, to a certain degree, control over conditions that affect the cars' schedule. This latter refinement allows maintaining practically a uniform elevator service.

TABLE I—ELEVATORS AND THEIR RATING

Number of Cars	Service	Floors Served	Speed, Ft. per Min.	Capacity, Pounds
3	Local pass.	1 to 9	600	3,000
5	Exp. pass.	9 to 23	700	2,500
5	Exp. pass.	23 to 36	700	2,500
1	Service	B to 37	600	3,000
1	Freight	B to 9	350	9,000
1	Freight	B to 1	50	4,000

The automatic-scheduling machine relieves the dispatcher of the responsibility for signaling the cars to start. It also allows him more time to direct the incoming passengers, to check up on the condition on the upper floors and assist the operators to maintain a uniform schedule.

As previously mentioned the control is of the automatic inductor type. With this system there is no mechanical connection between the parts of the control that move with the cars and the stationary parts in the hoistway. The selector switches in the machine room are also electrically operated. Since the selector switches are operated electrically they may be grouped at any convenient location, the same as the rest of the control equipment in the machine room. One of these switches, shown on the right, Fig. 2, consists of two sets of moving contacts *C* that travel vertically over rows of stationary contacts. It is necessary that the moving contacts bear a definite relation to the position of the car in the hoistway so that the latter will be stopped accurately at the floors. The drive on the selector consists of two induction-synchronous motors, one geared to the secondary sheave and the other to the moving contacts on the selector switch. As the position of the armature in the motor geared to the secondary sheave changes, the armature of the motor of the selector follows in synchronism. Consequently the position of the car in the hoistway bears a definite relation to the position of the moving contacts on the selector switch.

The inductor switches are located on top of the car, as at *A*, Fig. 3, and each consists of a normally closed

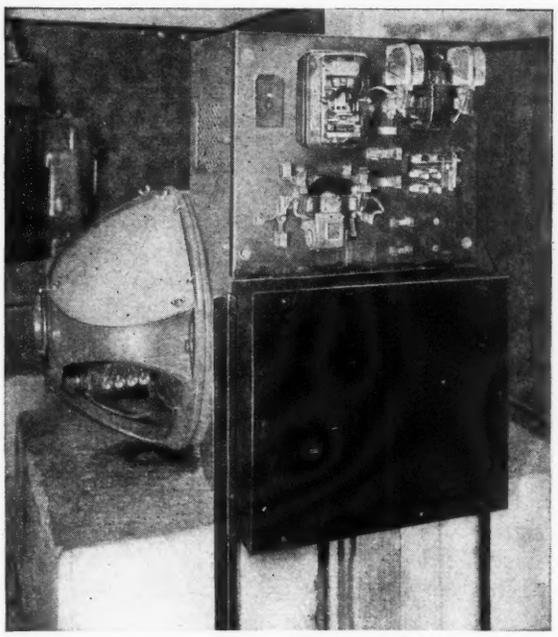


FIG. 6—THE CONTROL OF EACH MOTOR GENERATOR SET IS MOUNTED DIRECTLY ON ITS MACHINE

These machines are mounted on cork blocks so that they cannot transmit noise or vibration through the building. The mounting is so flexible that the machine can be rocked by hand as easily as if they were supported on flexible springs.

contact with a coil and magnet. These switches are totally inclosed with a cover of non-magnetic material to protect them from dust and dirt. In the hoistway, mounted on the guide rails are plates *B* of magnetic material, and are known as the inductor plates.

When a floor button is pressed either in a corridor or in the car, a circuit is completed to the stationary contacts on the selector switch to stop the car at the floor

TABLE II—LIST OF ELEVATOR EQUIPMENT

Equipment	Manufacturer
Elevator machines and controls	Westinghouse Electric Elevator Co.
Floor lanterns	Westinghouse Electric Elevator Co.
Position indicators and telltale annunciators	Westinghouse Electric Elevator Co.
Position indicators in cars	Westinghouse Electric Elevator Co.
Call-indicator system	Westinghouse Electric Elevator Co.
Cabs	The Tyler Co.
Landing doors	Dalhstrom Metallic Door Co.
Automatic scheduling system	Elevator Supplies Co., Inc.
Door operators	Elevator Supplies Co., Inc.
Cables	Am. Steel & Wire Co.
Hoisting-cable equalizers	Evans Elevator Equalizer Co.
Guide-rail lubricators	Yvan Zenon
Guide-rail lubricators	Westinghouse Electric Elevator Co.
Watt-hour meters	Westinghouse Elec. & Mfg. Co.
Mileage recorders	Veeder Mfg. Co.
Stop counters	Veeder Mfg. Co.

corresponding to the button pressed. At a given distance before the car reaches this floor the moving contacts on the selector switch come into a position to complete the stopping circuit through the coil in the first slow-down inductor switch on the car. This, however, does not cause the inductor to operate until it comes in front of the first slow-down inductor plate. At this position the inductor switch opens and starts the car slowing down. From this it will be seen that the car starts slowing down at a definite position in the hoistway even if there be a slight variation in the position of the moving contacts on the selector. After the first slow-down inductor plate is passed the second slow-down inductor switch comes in front of its plate and functions to further retard the car in preparation for stopping at the floor, which is done by the stopping inductor. The stationary and moving part of the inductors never come into contact; therefore, they are quiet in their operation.

The elevator-machine motors' control is of the variable-voltage type, designed to give the car a constant speed in either direction of travel. This uniform speed makes it possible to stop the car under all conditions of load in the same distance, making accurate landing stops in the minimum of time and distance. Each elevator is supplied with power from a motor-generator set, one of which is shown in Fig. 6. The movements of the car are controlled entirely by control of the generator's voltage. The strength and direction of the generator's voltage determine the speed and direction of the elevator motor, which in turn determines the speed and direction of the car. The strength of the generator's field is increased to increase the speed of the elevator motor and dcreased to slow down and stop the motor.

Not only have the latest devices been provided for efficient handling of traffic on the cars, but other features of the elevators' operation have been given equal consideration. To take care of unequal loading of the hoisting ropes, due to unequal stretch or from other causes, equalizers *E* have been installed in the cars' crossheads, Fig. 3. On the equalizer each group of two ropes connects to the ends of a short equalizing bar, and these bars are connected to the car by an equalizing cable.

A watt-hour meter has been provided on each elevator to show the power consumption, mileage recorders are installed to record the car's travel and stop counters are used to show the number of stops each car makes. Comprehensive records are kept of the elevators' operation. How the cars are being operated and the records kept will be the subject of another article.

Appreciation for the assistance rendered in the preparation of this article is due W. Pfaendler, Superintendent of the News Building.

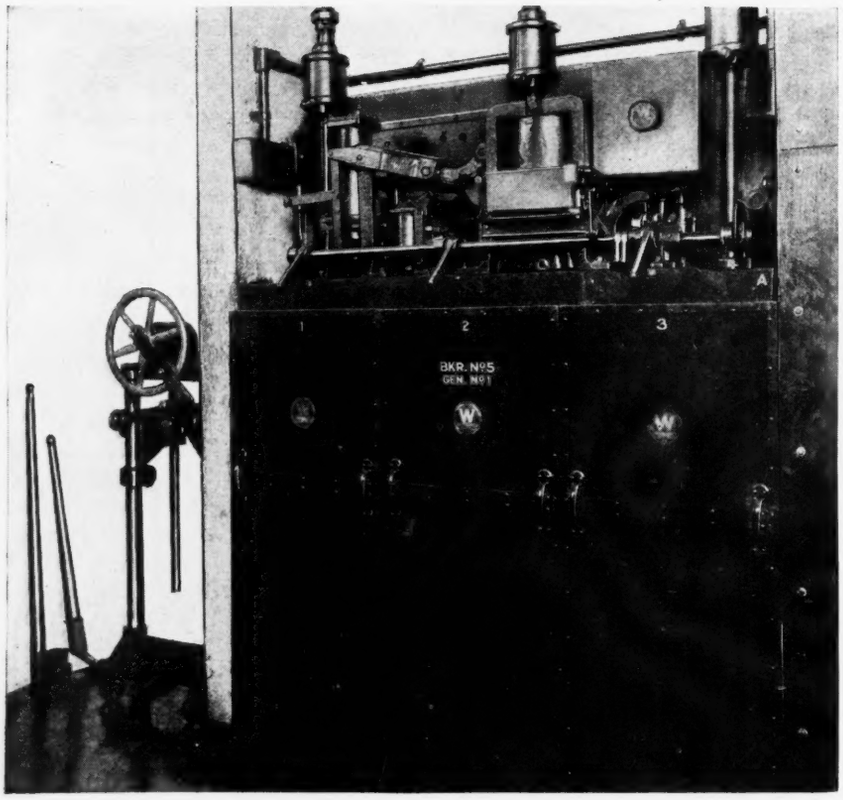


Fig. 1—Operating handle and tank lifting device kept in a convenient place near the circuit breaker

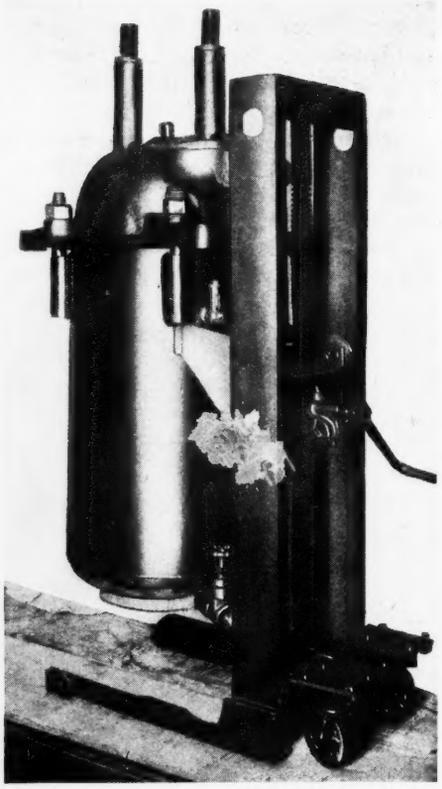


Fig. 2—Tank lifter supports complete switching unit

Proper Tools Expedite Breaker Maintenance

By E. K. READ
Circuit Breaker Engineer
Westinghouse Electric & Manufacturing Company

THE REMOVAL of the tanks to inspect the contacts of an oil circuit breaker requires a longer time than any other item on the maintenance schedule. This time can be materially shortened by having proper equipment kept in an accessible place at all times.

A lifting device is necessary where tanks hold more than 10 gal. of oil or weigh more than 100 lb. A good lifting device for handling the tanks will more than pay for itself by the saving in maintenance time, since the crew to do the work is kept to a minimum. The lifter should be power operated where a man cannot do the operation in a reasonable time without exhausting himself.

The operating handle used when adjusting solenoid or motor-operated circuit breakers may be kept in the same place with the tank lifter. Such a grouping of this equipment is shown in Fig. 1. In this case the tools are kept in the main cell structure adjacent to the breakers.

If the lifting device is strong enough to handle the weight of an entire breaker unit, installation and emergency maintenance work which involves the replacing of the unit is made much easier. Fig. 2 shows a tank lifter being used to handle a complete unit. The front wheels of the lifter are of the swivel type to permit turning corners and getting into and out of the cell. The frame is shaped so that the tank or breaker unit may be set down on the floor and the lifter withdrawn to be used in handling other tanks or units.

▼ ▼ ▼

What Is Energy Worth?

ENGINEERS strive to save heat units because heat has value. Money and effort that may properly be invested to save these units must be measured by their value. Hence the question: "How much is a heat unit worth?" Or, to put it another way, "how much is energy worth per million heat units?"

Obviously this value must vary enormously as energy progresses to more refined forms. At one extreme is coal at the mine. With an arbitrary value of one dollar per ton, heat in mine coal is worth about four cents per million. The other extreme is encountered by the housewife paying perhaps eight cents per kilowatt hour for electricity. The energy delivered to her flatiron or toaster is worth $23 per million.

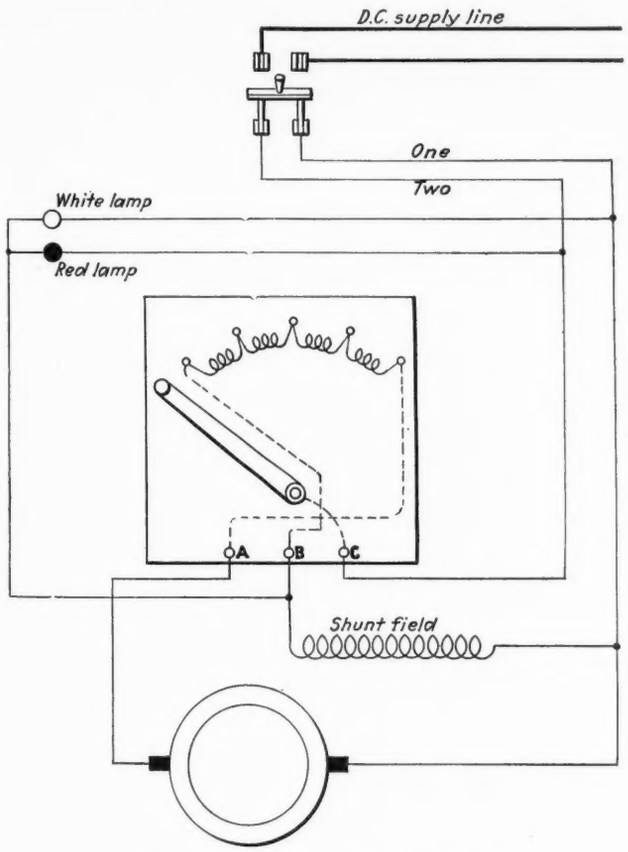
Between mine and ultimate consumer we find intermediate values. Delivered coal at $5 is worth approximately twenty cents per million heat units. Heat in fifty-cent steam (per thousand pounds) is worth about 45 cents per million. Switchboard current, at six mills per kilowatt hour, is worth $1.75 per million heat units. With two-cent current, a million B.t.u. is worth $5.85.

This tremendous range of value of heat shows the importance of the accumulated losses, labor, operating and fixed charges that pile up on the defenseless B.t.u. as it travels from mine to ultimate consumer of energy. It also suggests caution in the interpretation of simple heat-flow charts. These charts generally contain no hint of this variation in value.

. . . RIGHT OUT OF THE PLANT . . .

Light Signal System for Direct-Current Motor

IT IS frequently necessary to locate certain motor-driven equipment in rather inaccessible places where it is not convenient to include it in the usual tours of inspection around the plant. In cases where these conditions exist it is advisable to have a signal of some kind to show when the motor is operating properly and to give warning if it stops for any reason. In the illustration is shown a light signal system used in connection with



Connection diagram for signal lights

a direct-current motor-driven vacuum pump located in a basement about 200 ft. from the engine room. The lights are placed in the engine room where they can be seen at all times by the engineer.

The operation is as follows: When the switch is closed the current flows along line one through the motor to terminal *B* on the starting box, which is connected to the red and white lamps. The other side of the red lamp being connected to line 2 the red lamp will light.

When the motor is brought up to speed the current from line 2 flows through the starting handle to *B* on the starting box, then to the lamps. As the other side of the white lamp is connected to line 1, this lamp will burn while the motor is running but the red lamp will gradually dim out as the motor comes up to speed.

Buffalo, N. Y. P. CALLAGHAN.

Better Radiation Distribution Reduces Heating Costs

A CONSIDERABLE SAVING in fuel and improved heating service resulted from a few simple changes in our heating system, which serves office and factory buildings. In one factory building, the rooms on the north side of the ground floor could be kept comfortable in cold weather only by putting steam on six hours before the factory opened in the morning. All floors were heated by one steam line, which meant unnecessary heating in some parts of the building. As all changes had to be made without buying any material, the final solution was to heat all pipe-coil radiation with high-pressure steam leaving the cast-iron radiators on the low-pressure line. As all reducing valves were located in the boiler room, this called for short runs of piping. The low-pressure trap was removed from the end of the pipe coils and the condensation carried to the high-pressure trap that drained the main line. By this procedure the heating time was reduced by three hours a day, which eliminated the wasteful practice of heating the entire building several hours before tenants arrived.

In the office building, the north-side top floor was the cold spot, and to have this room at 70 deg. by 8 a.m. often required turning steam on at midnight, especially on Monday morning, The top floor had exactly the same amount of radiation as the floor below, yet the temperature would be 5 to 6 deg. lower. As a result of overheating the lower floors windows were opened frequently and two radiators would be shut off most of the time. To obtain a more uniform temperature these radiators were transferred to the top floor and other radiation transferred from sections where it obviously was not needed. This five-story building was adjoined on the north by a four-story structure, hence the top floor received the wind effect and should have been equipped in the beginning with 50 per cent more radiation than

the other floors, which was the result that we finally attained.

We had 4,500 sq.ft. of direct-steam radiation in the north section which was controlled by one main valve. As we reduced the radiation of the overheated rooms to some extent, the net increase in total radiation in this section was only 100 sq.ft. We figured the saving as follows:

Originally, steam was kept on 4,500 sq.ft. for 12 hours a day. After the changes steam was on 4,600 sq.ft. for 10 hours a day and $(4{,}500 \times 12) - (4{,}600 \times 10)$ is a difference of 8,000 sq.ft.-hours, equal to approximately 2,400 lb. of steam a day. An additional saving of 2,000 lb. of steam a day was estimated by eliminating 75 deg. temperature on the lower floors, steam costing 55 cents per thousand pounds with oil as fuel.

Springfield, Mass. A. F. SHEEHAN.

Where Small Savings Made Large Profits

OBVIOUS opportunities for improvement or savings at various points in an industrial plant are often overlooked because the loss represented is small or because those who are in immediate charge of an operation have, through long daily association with the particular plant or process, become so accustomed to existing conditions that they accept them, disadvantages and all, as inevitable.

In connection with a screening operation for wood chips, the fine particles dropped into three hoppers from which they were led by a manifold to the suction of a small blower and discharged through a pipe, or duct, about 50 ft. long to a point on the floor in front of a small horizontal return-tubular boiler. A fireman was kept on duty at this point 24 hr. a day to shovel this material into the furnace, to control feed water and to attend to a few other odd jobs.

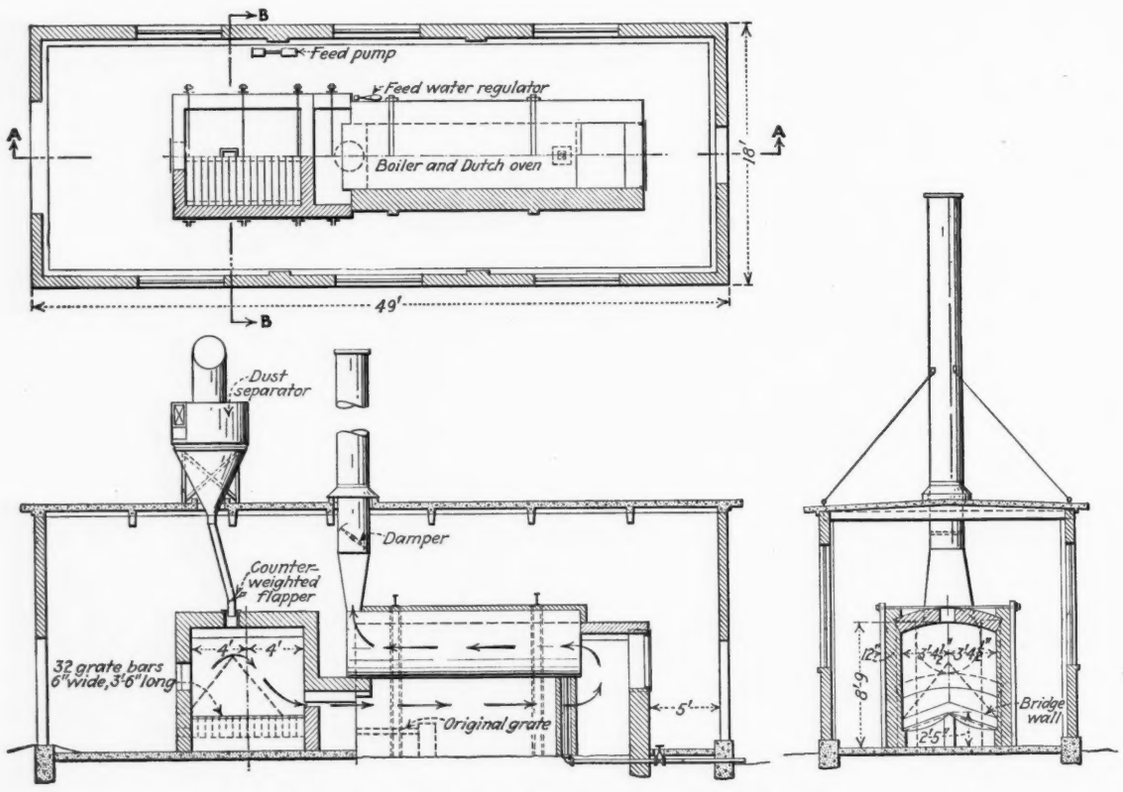
The manifold in the fan suction had been made too large and was not completely airtight; it frequently plugged up, and two or three truck loads of material per day accumulated on the floor to be shoveled up again and carted to the boiler house.

Observations on the amount of water fed to the boiler indicated that the value of the steam generated was $2.75 a day; so with a labor charge of $6.60 a day the operation was a losing one.

When the boiler house, a ramshackle structure 20x40 ft., was gutted by fire which started in the dust pile on the floor an opportunity was presented for making a number of improvements in the boiler plant.

A new manifold and discharge pipe for the blower were constructed of smaller size to maintain the air velocity sufficiently high at all points to keep the material in suspension; then a cyclone collector was set up and arranged to discharge directly into a new Dutch oven furnace, a system which provided automatic fuel feed. Finally, a simple float-type boiler feed control was attached to the boiler, and a pressure governor was purchased for the boiler feed pump. The boiler house itself was rebuilt with brick walls and a concrete roof to reduce the fire hazard.

With these changes the entire operation became automatic, and the men formerly employed as firemen were transferred to more profitable pursuits. Rubbish accumu-



Section of new boiler plant equipped with Dutch oven furnace arranged for burning waste wood fuel

lations from all parts of the mill, formerly dumped on the boiler house floor, were shoveled by the truck crew, a load at a time, directly into the Dutch oven through large doors placed at convenient height. The whole alteration, including the new boiler house building, was completed at a cost of about $3,900, and the labor saving was $1.980 a year. A. S. WELLS.

Kingsport, Tenn.

Installing Water Walls

THE ANSWERS appearing in the Sept. 16 number to the question at what rating one is justified in adding water wall surface do not seem to me to sufficiently cover the principles on which the decision as to whether or not to use water walls should be based.

Protection of refractories is, of course, the ultimate desire, but along with this goes ease of operation, such as cleaning fires and maintaining a proper fuel bed. The function of water walls is to lower the temperature of the furnace or of the material adjacent to them. This lower temperature may be desired locally, as in the case of side and rear walls of a multiple-retort stoker, or the arches and side walls of a chain-grate stoker. Lower temperature may be desired generally throughout the furnace to prevent formation of clinker in the fuel bed of a stoker, to prevent formation of slag in a pulverized-coal furnace, or to prevent slagging of fly ash, which may close up the passage between the boiler tubes in either a stoker or pulverized-coal fired boiler.

If local protection is required for a stoker-fired furnace, then water cooling should be applied at such points as are exposed to clinker formation, such as side and rear walls of an underfeed stoker, and only that region subjected to clinker formation should be covered. Here it is a case of providing a cold surface to which clinker will not stick, and little heat is absorbed by such surface.

If the nature of the installation is such that the temperature of the furnace limits the rating, then water-cooled surface should be applied to reduce this temperature to or slightly below the fusion point of the ash. It, of course, becomes an economic question whether to provide more boilers to operate at lower rating or to install water walls to permit higher ratings on fewer boilers.

Each installation is a problem in itself, and no general rule based on horsepower, rating or furnace volume can be applied. The factors that enter the computation are: the amount of radiant heat-absorbing surface exposed, the fusion point of the ash, the amount of heat released in the furnace and the excess air used.

Furnace volume enters the problem only in so far as the proper size and shape of furnace is provided to complete combustion within the furnace limits.

Many cases are on record of ample furnace volume being provided, without sufficient heat-absorbing surface exposed to the fire, and excessive temperature resulted, limiting the rating or causing inefficient operation.

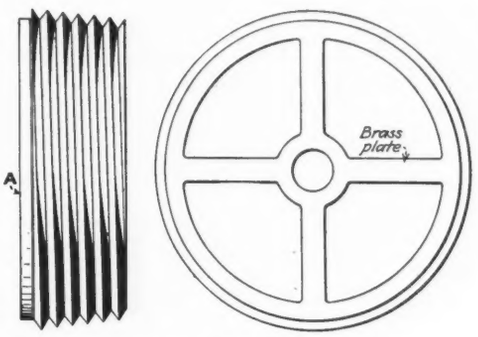
It is, therefore, evident that the data given in the question is not sufficient to permit a definite answer, for rating is not the sole determining factor for the amount of water wall surface required.

JAMES W. ARMOUR,
Engineering Manager,
Worcester, Mass. Riley Stoker Corporation.

Extension Plate on Pump Valves

IN A plant where I was employed the metal valve seats on a steam pump wore rapidly because of considerable fine sand in the water. After the seats had been refaced several times the top of the seat was lower than the deck when the valve was screwed into place. To bring the seat back to its original height a piece of sheet brass was cut having a diameter slightly less than the over-all diameter of the valve seat. Holes were cut in the brass plate to conform with the holes in the seat.

To attach the plate to the seat one side of the plate was heavily tinned, as also was the valve seat. Then the two



Pump valve with renewable plate

were put together, the necessary heating being done by a piece of heavy flat iron heated to a red glow and laid on top of the plate. As the brass sheet was much harder than the seat casting, it resisted the action of the sand much better. When the extension seat ultimately got worn it was unsoldered and reversed or renewed.

Lakeview, Ont. J. E. NOBLE.

Trouble With Centrifugal Pump Caused by High Speed

AT CORDOVA, ALASKA, while on a trouble job, I was called to a cannery where a new centrifugal pump had just been installed. The pump was located on a dock close to the water, and the motor on a staging 6 ft. above the pump.

The nature of the complaint was that "the pump wasn't delivering enough water," that it was running warm and that it was impossible to keep the proper size of fuses in the motor circuit.

I checked the motor and found nothing wrong electrically. Then I looked over the pump and found that the same size of pulley was on the pump as on the motor; consequently, the pump would run practically the same speed as the motor, which was 1,740 r.p.m.

The only solution I could find was to cut the speed of the pump down to 900 or 1,000 r.p.m.

Acting on this suggestion, the management had a countershaft installed with the proper size of pulleys to reduce the speed of the pump to around 1,000 r.p.m. At this speed the pump appeared to do what was expected of it.

Butte, Mont. RALPH E. MACKAY.

From Among Readers' Problems

Conducted by
L. H. MORRISON

OPERATING BOILER WITHOUT WATER COLUMN—*Is it possible to determine the water level in a boiler if the water column is defective and the glass broken?* V.M.

Under such conditions the fires should be pulled and repairs made. If the boiler has a fusible plug the plug should blow when the level gets low, but to avoid undertaker's bills it is wise to pull the fires.

JOULE-THOMSON EFFECT—*In several engineering articles I have encountered mention of the Joule-Thomson effect. Just what is this?*

C.P.

When Joule was endeavoring to establish the mechanical equivalent of heat, Robert Mayer, a German scientist suggested a good unit of measurement. He reasoned that the return of the external work during compression was solely responsible for the rise in temperature and in this way he could establish an equivalent value in heat for work spent. Joule and Thomson attacked the problem and found that for air the heat developed exceeded the work spent; and for CO_2 the amount in excess was $\frac{1}{2}$ of the work spent. For hydrogen the heat developed was less than the work spent.

Considering the reverse of compression, that is, expansion, if a gas were expanded, and no work done by it in expanding, its temperature should not change. So Thomson proposed allowing gas to expand through a plug of silk wool, stuffed into a bamboo tube to the pressure of the atmosphere. Precautions were taken against heat being gained or lost to the surroundings during the process. It was found that, though no external work was done during expansion, so that the temperature should have been constant, there was a pronounced cooling effect, the amount depending upon the character of the gas, the pressure range through which it was expanded, and also upon the initial temperature, being greater with lower temperatures.

In the case of hydrogen the effect was heating instead of cooling, but upon the gas being cooled considerably before the start of the process, the effect became cooling. For air, this cooling effect was approximately one-quarter degree Centigrade for each atmosphere drop in pressure between certain limits; with CO_2 it was much more, varying with both temperature and pressure. Values for CO_2 ranged from below one deg. C. per atmosphere to $1\frac{1}{2}$ deg. C. per atmosphere drop.

A Question for Our Readers

OUR oil engine is insured and recently a cylinder head fractured. In arriving at the present worth of the head before fracture what should be taken as the average life of a head? C. V. R.

Suitable answers from readers will be paid for and published in the Nov. 18 number

PREVIOUS QUESTION

Discussed by Readers

THE QUESTION

OUR 5-stage, turbine-driven centrifugal boiler-feed pump at times rumbles and vibrates badly. What is the cause?

A.B.D.

INSUFFICIENT suction pressure, hot water, broken wearing rings, or partially-blocked impellers will cause vibration and rumbling.

The suction pressure at the pump must be several pounds higher than the vapor pressure of the water at the given temperature. A loss of pressure would be caused by deposits in the suction line or by a valve not fully open. Water which is too hot will cause the pump to steam bind at times of suddenly reduced load; venting from top of pump will usually stop the trouble until the water temperature can be reduced to normal. A broken wearing ring or blocking of water passages in pump impeller will throw the rotating element out of balance and cause more or less trouble until pump is opened and repaired or cleaned. J. C. PORTER.

Saltville, Va.

I BELIEVE the trouble with the five-stage boiler-feed pump is due to a loose diaphragm. This condition may be caused by a heavy gasket in the pump-case joint. If the joints are smooth and in good condition a thin piece of kraft paper makes an excellent gasket and will allow the cover to be pulled down tight against the diaphragms.

I have personally run into this condition several times and in each case was able to completely stop the rumbling and vibrating by the above method.

D. J. WOLLAM.

Port Townsend, Wash.

THE EFFECT may be produced by a variety of causes.

The pump may become slightly vapor bound when using high-temperature water with too low a gravity suction head. If the pump is fed from a gravity tank, that is, has a positive suction head, as is usually the case, this can be largely prevented by running a small line, open to the atmosphere, vertically from the suction end of the casing to a height a few feet above the feed tank. Most pumps have pet cocks or bleeder valves at each stage on the casing, whereby vapor can be released. If continual trouble is encountered these can be kept open at all times just sufficiently to prevent vapor binding.

The pump may become air bound either from separation of entrained air in the water or from air leaking in at the gland on the suction end. The remedy is the same as in the case of vapor binding, except that any gland

leakage should be stopped by proper packing.

If the pump is operating at the limit of its capacity and the demands are slightly greater than this rate, the pump will have a tendency to surge and race, and there will be a fluctuation of delivery pressure shown on the gage. It should be remembered that this condition may obtain for any number of settings if the pump has a drooping characteristic. Hence for any given setting and constant steam supply if the corresponding pump capacity is exceeded the pressure drops and the pump speeds up. In the case of feeding a boiler, the pressure will not drop below the boiler pressure, but at the peak of the curve even a small drop may cause overspeeding and consequent rumbling and vibration. This will not occur, however, if some type of governor control is fitted to maintain the desired pressure by increasing the steam supply as the overloading begins. Lacking this, the steam supply must be increased by hand control or the pump operated continuously at a point far enough from the peak of the pressure-capacity curve to insure that the maximum demand will not result in going beyond this peak. For most boiler-feed service an excess pressure (pressure above boiler pressure) of 50 lb. is ample.

If more than one pump is operating on the same line in parallel, all pumps must be quite accurately set to deliver the same pressure and capacity, otherwise pounding and racing with consequent vibration may occur. The pumps can best be placed on the same characteristic point by checking their speeds and delivery pressures together. For cases where pumps operate in parallel there should be check valves between each pump and the main delivery line.

T. A. SOLBERG.

San Pedro, Calif.

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PERIODIC VIBRATIONS and rumblings in a multi-stage feedwater pump can be caused by different things under different conditions. The most logical of which to investigate first, is the possibility of the pump losing its water, or getting vapor-bound. Even with extremely high heads on the supply water at high temperatures, the slightest restriction in the suction line will often cause trouble.

If the water is measured through a V-notch or weir meter, some times the packing around the control rod that is connected to the float is too tight, causing the meter to lose its water. If this does happen it will show up on the recording chart as a series of vertical lines so close together that it will make one wide line on the chart.

The thrust bearing on a feed-water pump will sometime give trouble, if it is worn to any great extent, or if the thrust collar should "back-off." Examine carefully the side of the wearing rings facing the thrust bearing, any signs of wear at this point is caused by a faulty or worn thrust bearing.

Lindale, Ga. COMER TURLEY.

IT IS my opinion that rumbling in the centrifugal pump is caused by air in the water reaching the pump. When water is cold and traveling at high velocity it does not liberate air as quickly as does water of a higher temperature and slower velocity. This air comes along in the suction line in bubbles, and a large quantity coming at once throws the rotating elements of the pump out of balance and causes vibration. This can even happen when the suction has a slight head and at times there is danger of the shaft breaking. Only recently we had a pump shaft break from pockets of air throwing the pump out of balance, even though we had a receiver on the suction of the pump to remove air entrained in the water.

Perhaps the pump in question is sucking hot water and if so there will be frequent rumblings even though the suction is under a head. This will happen when the water becomes too hot and pockets of steam will act like pockets of air and throw the pump out of balance. This happened to me in a plant having the feed heater 28 ft. higher than the pump. Even then, when the feedwater reached a temperature of 220 deg., the pump would vibrate and sometimes lose its suction. The only remedy was to keep the temperature below 220 degrees.

JOSEPH O'BRIEN.

Rosedale, N. Y.

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IN A CENTRIFUGAL PUMP the pressure at the eye of the impellor is lower than at any other point in the suction line. This is due to friction losses and the changing of pressure energy into velocity energy. If the pressure at this point drops below the vaporization pressure corresponding to the water temperature, the feed water will flash into vapor. The pump will then churn water and vapor at high speed, producing a noise similar to that of a stone crusher in action.

Boiler feed pumps require a static head of from 12 to 20 ft. over the vaporization pressure, on the suction side, depending upon the water temperature and pump speed, to provide sufficient pressure at the impellor eye. In the case in question it is evident that the head becomes too low at some capacities causing flashing of water into vapor, which, in turn causes the vibration.

HOWARD GARNAR.

Glen Ridge, N. J.

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IT IS very hard to say what causes the boiler-feed pump to rumble and vibrate without seeing it in operation, as there are a number of things, any one of which would cause trouble similar to that mentioned. The question does not state if the vibration is at regular intervals or if it just occurs once in a while and at no definite time.

The vibration could be caused by misalignment, but in this case, it would probably be constant, unless there were times when the expansion corrected the misalignment. It may be in perfect alignment, but due to change in temperature of the feed water, the pipes may expand and place strains on the unit causing the vibration. It is possible that the unit is in a direct draft causing unequal expansion between the turbine and pump, which would produce misalignment, and cause the unit to vibrate. The critical point of the floor and foundation may be very near that of the turbine and pump, and when the two get in synchronism, the vibration may be very pronounced. In this case, it would come and go as the load and speed of turbine changes. If this is the case, it could be eliminated by changing the supports under the foundation so as to change the critical period of the floor and foundation.

The rumbling noise may be caused by the feed water being too hot for the pump to handle without cracking. The foundation may be setting on a floor without any support directly under the unit itself, and the floor acts as a sounding board, thereby amplifying any noise from the unit. There may also be foreign matter in the pump, but if this is the case, I am inclined to believe that this would be noticed in the capacity of the pump falling off.

C. N. JOHNSTON.

New Haven, Conn.

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WHEN a centrifugal boiler-feed pump rattles and vibrates. it is a sign of steam-binding or cavitation. The direct cause is insufficient absolute suction pressure for the temperature of the water being pumped. The indirect cause may be that the feed-water heater is not elevated high enough for water temperature obtaining during noisy periods.

The suction line may be of such a size that when other pumps are started, they will increase the friction loss through the suction line to such a point that the intake pressure on the noisy pump will be lowered to an extent that the hot feed water flashes to steam at the pump suction. This is very apt to occur when a pump is at the end of an undersized suction line with other pumps ahead of it.

If there is a check valve in the suction line and it should be sticking at times, this might also reduce the suction pressure appreciably and result in cavitation with attendant noises.

An appreciable change of speed and quantity of water pumped might also explain the trouble, since friction loss in the suction line would increase as the square of flow and possibly reduce the suction below the smooth-running point, while the cooling of water en route would be lessened, so that pump would get hotter water at a lower pressure.

Therefore, if a pump runs quietly part time, it is quite certain that during spells of trouble the temperature of water has increased, the pressure decreased, or both have occurred.

R. S. LANE,
Mechanical Engineer,
Pocahontas Fuel Co., Inc.

New York City.

WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

Single-Pass Three-Drum Waste-Heat Boiler of Bent-Tube Design

SINGLE horizontal gas pass, high-heat transfer, effective dust precipitation, low draft loss and freedom from brickwork trouble are some of the important features of the new waste-heat boiler brought out by the Babcock & Wilcox Company, 85 Liberty St., New York City.

Referring to the illustration, the boiler comprises three horizontal drums, one upper steam and water drum and two lower mud drums, connected by bent tubes. The tubes are staggered and are bent closer together in the rear portion than in the front portion of the unit in order to maintain the gas velocity and to give better heat transfer. Vertical baffles *C* are inserted in the rear portion to prevent gas lanes and assist in the dust precipitation. It is pointed out by the manufacturer that by reason of the vertical arrangement of the tubes and baffles unusually effective dust precipitation is obtained, the dust dropping into soot hoppers located below the two lower drums. The soot hopper is made continuous and divided into a number of sections by means of vertical baffles. Multiple clean-out connections are provided on the bottom of the hopper.

To further prevent the collecting and lodging of dust on the superheater headers the inverted type of superheater is used. The complete superheater unit is suspended in the gas pass as shown, the position in the pass, with respect to the gas inlet, depending upon the gas temperature and the degree of superheat desired.

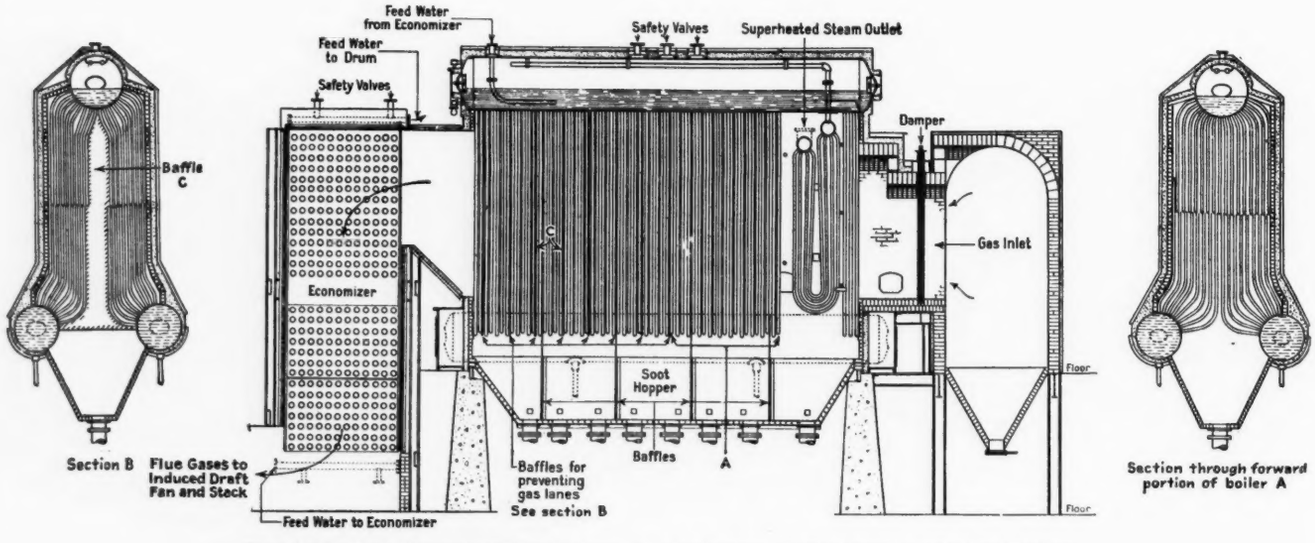
Steam connection to the superheater is by means of two saturated delivery pipes passing through the upper drum and connecting directly to the inlet leader.

To permit free expansion of the boiler and at the same time eliminate brickwork trouble and air infiltration, the firebrick, insulation, and tile are supported independently of the boiler within a steel casing. The boiler itself is supported by the two lower drums.

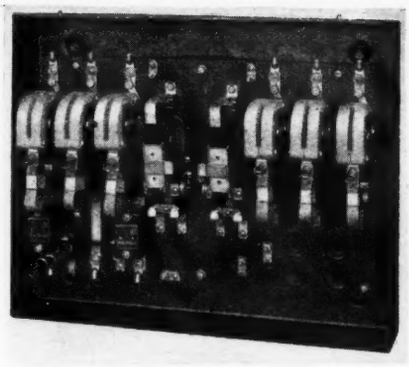
In the typical installation shown an economizer arranged for down flow of gas with dust hopper at the bottom is included. Either a steel or cast-iron economizer can be used.

New Magnetic Reversing Switch for Larger Motors

THE NEW inclosed magnetic reversing switch illustrated is designed to throw small alternating-current motors directly across the line. It consists of two triple-pole, mechanically interlocked, magnetically operated contactors with restricted-type blowouts, and with a normally open interlock on each contactor. It also has two hand-reset temperature-overload relays. The contactors are mounted side by side on a molded base, instead of back to back as in the previous design. The



Longitudinal and cross-sectional views of single-pass, three-drum, waste-heat boiler



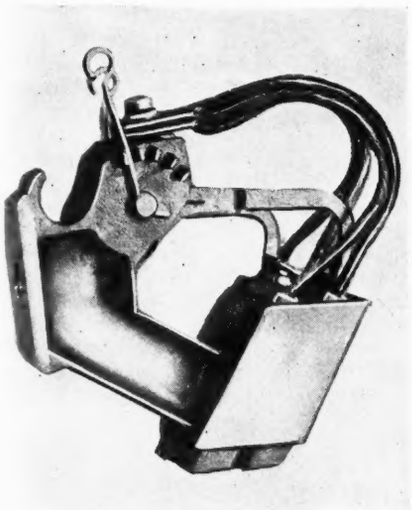
Switch with cover removed

new starter, which is put out by the General Electric Co., Schenectady, N. Y., supersedes the previous model, designated CR-7009-B-5.

Double-Brush Holder to Prevent Sparking

TO REDUCE the possibility of sparking between the brushes and commutator of large current electrical rotating machines, the new double-brush holder of die-cast construction illustrated has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

By the use of two individual brushes in a double brush holder, both brushes are never bounced off the commutator at the same instant.

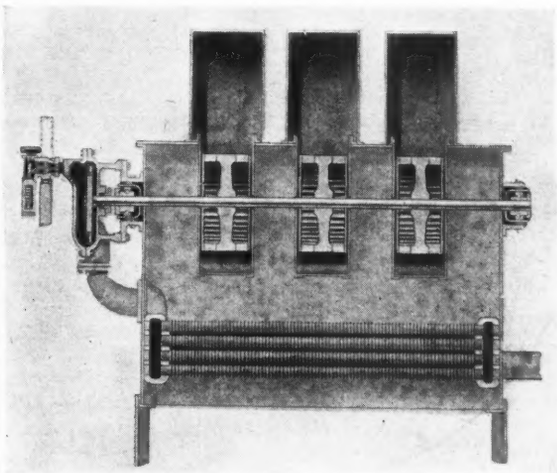


Double brush holder

This design is said to insure constant contact and eliminate the voltage drop between brush and commutator usually caused by the brush's being bounced out of contact owing to a slight difference in height between adjacent commutator bars.

Steam-Turbine-Driven Unit Heater

A LINE of steam-turbine-driven unit heaters of the high-velocity, multi-fan type designed for either high-pressure or low-pressure heating systems has been introduced by the Automatic Turbo Heater Company, 343 South Dearborn St., Chicago, Ill. The shaft speed is low, being only 1,140 r.p.m., which tends to insure quietness and freedom from vibration. The turbine rotor is mounted directly on the blower shaft as shown. The impulse wheel is fitted with stainless steel buckets, and a nozzle with adjustable needle valve is provided. A thermostatic valve controls the amount of steam admitted to the turbine as governed by the room temperature.



Section of heater showing arrangement of turbine-driven fans and combined steam condenser and air heating element

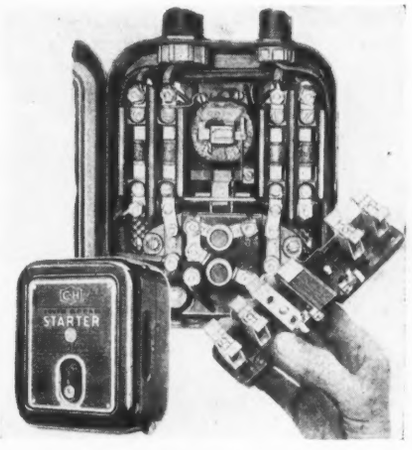
A combined steam condenser unit and air heating element is mounted in the casing directly below the fans. It consists of $\frac{3}{4}$-in. copper tubes with continuous spiral fins and cast-iron header suitable for 200 lb. pressure. Three multi-vane type fans are used to propel the air, the complete fan assembly being mounted on self-aligning anti-friction bearings in adjustable housing. The unit is made in five sizes in both floor and ceiling types.

Improved Motor Starter With Twin-Break Magnetic Contactor

CUTLER-HAMMER, INC., 190 Twelfth St., Milwaukee, Wis., has redesigned its entire line of Type AAA automatic starters for small alternating-current motors, to incorporate a newly developed twin-break magnetic contactor. The twin-break principle reduces the arc voltage by half, and arc pockets, by reducing the air content around the contacts, prevent the formation of a destructive arc. The contacts are of heavy coin-silver, which is said to retain its current carrying capacity even if oxidized.

A magnetic latch has been added to prevent accidental closure of the contacts if the starter is accidentally bumped or tilted—the latch must be drawn aside by the operating magnet before the contacts can close. A new hinge structure facilitates removing and replacing the contact board and insures correct replacing of the board before the starter can operate. In the illustration the contact board is shown removed from the starter.

These new contactors are made in three- and four-pole types. The maximum rating for two- or three-phase current are: 3 hp., 110 volts; 5 hp., 220 volts, and $7\frac{1}{2}$ hp., 440 or 550 volts.



Starter with twin-break contactor

NEWS of the FIELD

Government Scientists Doubt Commercial Possibilities of Claude's Power Scheme

Munroe, Hood, Burgess and Humphreys attest soundness of Claude's theory but believe it lacks economic practicability

PROF. GEORGES CLAUDE'S demonstration that the difference in temperature of water on the ocean floor and on the surface can be utilized to produce power is regarded by government scientists as the closest approach made to date in the practical application of an old theory. Some doubt as to the commercial practicability of the project will persist, however, until the French scientist actually puts on a demonstration without resorting to auxiliary power.

Dr. Charles E. Munroe, widely known physicist of the Bureau of Mines, said he regards Professor Claude's achievement as one of the outstanding steps in the advancement of science since Faraday produced electrical energy by cutting the lines of magnetic force. Dr. C. P. Hood, chief of the technologic branch of the bureau, stated that it would require a tremendously large plant to develop any considerable amount of power but he is confident that Prof. Claude, having approximated success, will be able to perfect his invention. This will lie principally, he said, in finding means of moving the vast volume of water required with the least possible expenditure of power. It is obvious that if the power needed for this purpose is just equal to that generated, there would be no excess for useful work. Dr. Hood stated that it would be possible to utilize Prof. Claude's system on Lake Superior.

Dr. George K. Burgess, director of the Bureau of Standards, stated that the French scientist's feat in harnessing the Gulf Stream has vast possibilities. It appealed to other government experts as scientifically interesting but far from warranting the construction of similar hydro-electric plants along the Atlantic seaboard. Dr. J. W. Humphreys, chief physicist of the Weather Bureau, was frankly skeptical. Utilization of thermal differences in water to generate power is a sound scientific principle, he said, but whether Professor Claude can produce more power than is required to pump the water is questionable.

This presents a big engineering problem to be solved in connection with the project, in the opinion of experts at the Bureau of Standards. The apparatus must furnish more power than it consumes in order to make the project profitable. Also, an economic problem arises in connection with the field for marketing the extra power produced and the production of this power at a cost that makes it salable in competition with power produced by the usual steam, hydro and diesel installations.

If these two problems can be overcome by Professor Claude, it is felt that the project should present good possibilities for the development of a new field for electrical power sources.

Safe Harbor to Install Largest Kaplan Turbines

Announcement has just been made of the letting by the Safe Harbor Water Power Corporation of a turbine contract of particular interest, both as to size and type of the waterwheels and the magnitude and nature of execution of the order. The Safe Harbor company, which was formed recently by the Aldred interests to construct and operate a large hydro-electric development on the Susquehanna River at Safe Harbor, Pa., about eight miles upstream from the Holtwood development of the Pennsylvania Water & Power Company, has placed orders for six hydraulic turbines, each with a rated capacity of 42,500 hp. under a 55-ft. gross head, or a total capacity in the initial project of 255,000 hp. Provision is being made in the foundations of the power house for six more turbines of the same size.

These turbines will all be of the propeller type with automatically adjusted blades. This so-called Kaplan-type turbine has blades shaped somewhat like those of a ship's propeller, but the angle of the blades will be changed as the hydraulic conditions and the load on the turbine change. The turbines will be the most powerful of the propeller type in the world and will be among the largest diameter wheels in the United States of any type.

Three of the turbines will be made by the S. Morgan Smith Company of York, Pa., and three by I. P. Morris & De La Vergne, Inc., of Philadelphia, but all will be of the same design so that substantially all parts will be interchangeable. The water passages from intake at racks to discharge of draft tubes will also be of the same design. This unusual arrangement was made possible by the cooperation of the engineers of the manufacturing companies and the power company and as a result of research work carried out by these engineers at the manufacturers' laboratories and the new hydraulic testing laboratory erected by the Aldred interests at Holtwood.

National Research Council Tours Laboratories

A nine-day tour of laboratories of various companies was started last week by the National Research Council. Some 100 industrialists, executives, bankers, and others interested in the work of centers of scientific development were included in the party. The schedule includes visits to the laboratories of the Bell Telephone Company, General Electric Company, General Motors Company, United States Air Service Engineering Division, American Rolling Mill Company, Aluminum Company of America, Mellon Institute of Industrial Research, United States Bureau of Standards, and National Canners' Association.

Automatic Pumping Featured at A.S.M.E. Oil Meeting

Discussion and demonstration of automatic pumping of oil was a feature of the petroleum division meeting of the American Society of Mechanical Engineers, held in connection with the International Petroleum Exposition at Tulsa, Okla., Oct. 6 to 8. A paper describing the development of automatic pumping was presented by J. B. Ford, J. B. McMahon and T. D. Williamson, members of a special research committee of

the society. In addition, an electrically operated fully automatic pipeline pumping station, erected at a cost of $90,000 by the society on the exposition grounds, demonstrated the feasibility of automatic pumping.

An "electrical brain" controls the station through hydrostatic pressure exerted by the oil in the tanks and lines. A break in either feeding or emptying lines causes a prompt cessation of flow through the defective line. The paper explained how this would tend to lessen losses resulting from broken lines because of the vigilance of the "electrical brain" in detecting when anything goes wrong and then acting to shut off the flow. The prediction was made that the next few years would see numerous automatic installations.

Arizona to Contest Validity of Boulder Canyon Act

The Attorney General of Arizona, K. Berry Peterson, Oct. 6, asked the Supreme Court of the United States for leave to file a bill of complaint in the name of the State in which it is charged that the Colorado River Compact between the seven states interested in the Boulder Canyon irrigation project is "grossly inequitable, unjust and unfair" and that the Boulder Canyon Project Act is unconstitutional.

The suit, according to the bill of complaint filed in the office of the clerk, would make the states of California, Nevada, Utah, New Mexico, Colorado, and Wyoming, defendants as well as the Secretary of the Interior, Ray Lyman Wilbur.

The bill of complaint filed by Mr. Peterson directly attacks the validity of the Boulder Canyon Project Act, providing for the erection of Hoover Dam, as an "excess of the powers granted to Congress by the Constitution of the United States," and declares it unconstitutional and void.

Natural Gas to Be Piped to Central Indiana

The Central Public Service Corporation of Chicago has made final arrangements for the production of natural gas in southeastern Kentucky and is now making plans for the transporting of natural gas to central Indiana. Through one of the subsidiary companies, Central Natural Gas Corporation, the corporation has contracted with the Kentucky-West Virginia Gas Company for the operation of a large tract of gas yielding land in Kentucky, from which location the gas will be supplied to the central Indiana and other markets along the route of the pipe line.

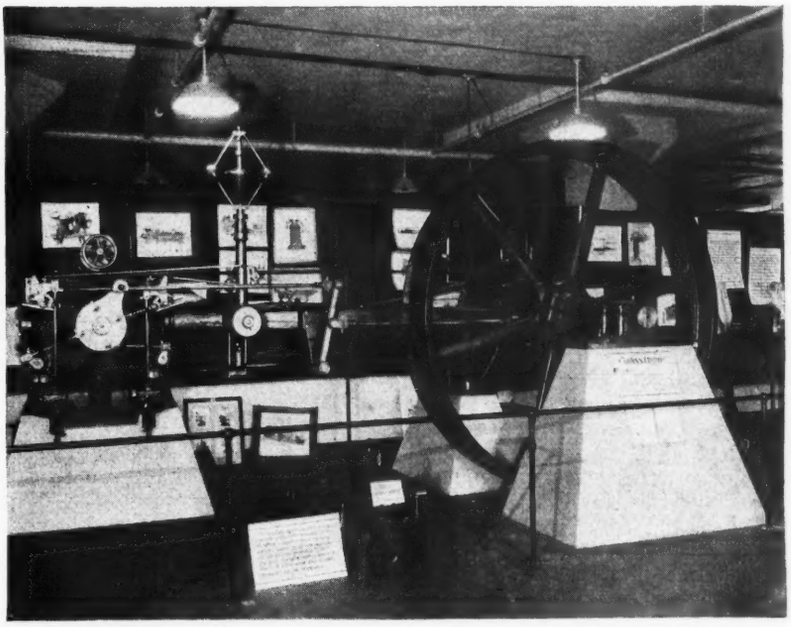
This project has just been started. Actual drilling operations of a few wells were started Oct. 1. This immediate start on the projected work is designed to fulfill the hope of the corporation to complete the main gas line and to develop a large supply of natural gas on or before Jan. 1, 1931.

It is a large-scale construction program to be finished within such a short time. Approximately 100 wells are to be drilled, and 1,500,000 ft. of 18-in. pipe are to be laid. Thousands of tons of pipe will be required for the main gas line alone, including 700 carloads of steel pipe and 80 carloads of pipe couplings. In addition to this material, at least 250,000 ft. of pipe for casing the wells will be needed. It is estimated now that the material and the labor to install it will represent an expenditure of approximately $12,000,000.

Busch-Sulzer Now Builds Solid-Injection Diesels

Since the introduction of the diesel engine into this country, the Busch-Sulzer Bros. Diesel Engine Company of St. Louis, Mo., has adhered consistently to the air-injection principle. Recently, however, this company obtained a license to employ the Hesselmann solid-injection system. Since that time a 3,000-hp., 10-cylinder, 19¼x26-in., 240-r.p.m. unit has been sold to the Freeport, N. Y., municipal lighting plant, and a 4,000-hp., 6-cylinder, 30x42-in., 125-r.p.m. engine has been sold to the Tucson Gas & Electric Company, Tucson, Ariz. These engines are of the two-cycle type and with the exception of the fuel system are identical with the standard Busch-Sulzer engine.

FORERUNNERS OF MODERN POWER UNITS



One of the many interesting displays at the Museums of Peaceful Arts' special exhibit depicting the rise of the machine age. The Corliss engine was built by William Munzer of New York in 1884, about the time that DeLaval, a Swedish engineer, invented his steam turbine shown in the foreground. Both are rated at 75 hp. Held in the News Building, New York City, the exhibit will run until Nov. 15

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News of Canada

Ruskin plant on line in November—To raise capacity of Lake St. John district—Single dam for Pend Oreille

ACCORDING to an official statement, the first unit of the British Columbia Electric Railway Company's new power development at Ruskin will be operating early in November. This unit will be delivering 47,000 hp. by that time. The downstream cofferdam is now being removed and water allowed to flood back to the main dam which is being completed up to the railway for the scheduled opening of the power house.

The three transformers which have been installed in the power house are the largest in the B. C. company's various developments. Each weighs 85,000 lb., and is of 14,667 kva. capacity. The transformers that have been installed at the Burnaby substation, the receiving end of the Ruskin transmission line, are only slightly smaller than those in the Ruskin power house. Final construction of the 66,000-volt transmission line from Ruskin to Burnaby is now in progress.

ENGINEERS of the Quebec provincial government are now studying a scheme for bringing the capacity of the hydro-electric energy developed in the Lake St. John district to over 5,000,000 hp. by turning the waters of Lake

Mistassini into Lake St. John, 150 miles south. Digging a canal three miles long and 30 ft. deep is thought to be all that is necessary to divert the waters. It is also thought that investigation should be made of the possibility of utilizing the water head from Lake Mistassini before the volume runs 150 miles south to Lake St. John where it could be used again.

ADOPTING PLANS which will embody construction of a dam, nearly 400 ft. high, across the Pend Oreille River the West Kootenay Power & Light Company will shortly apply to the British Columbia Provincial Water Board for approval of the undertaking. The single dam project had formerly been dropped in favor of a two-dam development, but engineering examinations, now nearing completion, have convinced the company that the bigger project is sound from an engineering standpoint and the two-dam scheme will be abandoned.

The company has already obtained water rights to harness the entire river, and governmental approval is regarded as certain. Recently the Reeves McDonald Mining Company, a former contender for the right to develop the Pend Oreille, withdrew its application, terminating a struggle which lasted more than a year. The mining company is applying for power rights on the Salmon River, a tributary of the Pend Oreille at a point where its work will not conflict with that of the West Kootenay Company. The West Kootenay's dam will be the highest in Canada and one of the most spectacular undertakings in America.

Foundation Sponsors Iron Alloys Research

A summary of world progress in the field of iron alloys, advance in which is held to be fundamental for American industry, is the object of a program of research enlisting the co-operation of more than 60 industrial and scientific organizations and corporations of the United States under the leadership of the Engineering Foundation. A fund of $230,000 to make possible a review of all available literature has been contributed by the organizations.

The scope of the investigation, which is described as the most ambitious ever undertaken in this field, was outlined by an advisory committee headed by John Johnston, director of research and technology of the United States Steel Corporation. Supervision of the program, which will require five years for completion, has been delegated to an Iron Alloys Committee, of which Dr. George B. Waterhouse, professor of metallurgy in the Massachusetts Institute of Technology, is chairman.

As its initial task, the Foundation and its co-operating organizations are conducting a critical review of all available literature in English and other languages.

Thomas B. Richardson Joins Hartford Insurance Co.

An increase in the number and variety of turbine risks the company is called on to inspect and underwrite, and prospects of an even greater volume of business in this line, are indicated in an announcement by the Hartford Steam Boiler Inspection & Insurance Company that Thomas B. Richardson joined the home office engineering department on Oct. 6 as chief engineer of the turbine and engine division.

Mr. Richardson is a graduate of Alabama Polytechnic Institute, has had

Thomas B. Richardson

broad experience with steam turbines and is familiar with developments in this class of apparatus during the past twenty years. He joined the turbine department of the General Electric Company in 1910 as an erector and was given increasing responsible charge of the installation, operation, and inspection of many large units. For the past two years he had been associated with the management of a utility plant in Florida.

Battersea Cable Tunnel Nears Completion

Considerable progress has been made with the 1,500-ft. tunnel for the new Battersea power station in London, England, and the cables joining the north and south banks of the Thames River have just been put in position. The tunnel has cost $225,000. The tube is constructed of cast-iron segments, with an inside diameter of 10 ft. There will be a permanent concrete gangway 2 ft. wide all the length of the tube.

Fifteen feet below the Thames bed, the tunnel is 68 ft. below ground level at the point where it passes under the river wall on the south bank. Only sufficient power cables for immediate needs are being installed, the plan being to increase the number as the station is developed.

Personals

DR. ELIHU THOMSON, dean of the General Electric Company's consulting engineers and research laboratory directors was tendered a banquet recently at the New Ocean House in Swampscott, Mass., in honor of his completion of 50 years of distinguished service to the electrical industry. More than 700 friends and associates attended, and the scores of congratulatory telegrams included messages from President Hoover, ex-President Coolidge, Thomas A. Edison, Owen D. Young, Gerard Swope, W. S. Lee, George K. Burgess and many others. E. W. Rice, honorary chairman of the company's board; Dr. S. W. Stratton, chairman of the corporation of the Massachusetts Institute of Technology, and President K. T. Compton, of the institute, spoke.

FRANK H. SMITH, formerly vice-president and general manager of the Elevator Supplies Company of Hoboken, N. J., has been made president of the company. Previous to his connection with this organization, Mr. Smith was associated with the Southwark Foundry & Machine Company in Philadelphia, Pa.

C. A. MCCUNE has been elected director of research and a member of the board of directors of the recently organized Welding Engineering Research Corporation. Interested in welding and welding methods for 25 years or more, Mr. McCune was previously connected with the American Chain Company of Bridgeport, Conn., and its affiliated concern, Page Steel & Wire Company.

HERBERT W. BOWEN, watch engineer at the South Street Station of the Narragansett Electric Company, Providence, R. I., has resigned to accept a position as chief engineer at a local institution. Mr. Bowen was in the service of the company for a period of 23 years. PRESTON L. HUNTER, turbine operator at the station, has been promoted to watch engineer.

STANLEY W. STODDARD, until recently assistant to Edward W. Dillard, electrical engineer in the Boston office of the New England Power Association, has been made superintendent of the newly created northeastern division of the Association with headquarters in the main building of the Lawrence (Mass.) Gas & Electric Company. Joining the Association in 1920, in the capacity of electrical designer, Mr. Stoddard has had charge of some of the company's most important electrical installations.

L. A. HARDING, president; C. W. FARRAR, treasurer, and F. C. HOUGHTON, director of the research laboratory of the American Society of Heating & Ventilating Engineers, have started on a trip to attend meetings of all the local chapters of the society with the exception of those in the far west.

Business Notes

STEEL TANK & PRODUCTS CORPORATION, Chicago, Ill., announces that it has secured the services of that portion of the engineering staff and coast-to-coast sales force which formerly designed and sold Zeolite water softeners and pressure sand filters for the Paige & Jones Chemical Company of Hammond, Ind. It is also announced that M. H. Cleaver, formerly New York district sales manager for Paige & Jones, will be district sales representative for the Eastern division of the Steel Tank & Products Corporation; O. E. Mitchell, district sales representative for Paige & Jones at Dallas, will represent the corporation in the state of Texas.

FULLER LEHIGH COMPANY, Fullerton, Pa., announces the removal of its Cincinnati office from the Traction Building to Carew Tower. H. E. Martin will continue in charge as manager.

INTERNATIONAL FILTER COMPANY, Chicago, Ill., has moved its general office to 59 East Van Buren Street. The laboratory at its No. 1 plant remains at 329 West 25th Place.

LINK-BELT COMPANY, Indianapolis, Ind., has appointed Warren Maxwell superintendent of the Dodge Works, to replace F. J. Oakes, deceased. Mr. Maxwell joined the company in 1922, entering the sales department. In January, 1929, he was made assistant superintendent, from which position he has just been promoted.

PACIFIC ELECTRIC MANUFACTURING CORPORATION, San Francisco, Calif., has opened a new factory office at 89 Broad St., Boston, Mass. G. A. Wright, who has had wide experience in the field of electrical transmission and distribution equipment, is in charge of the new Boston headquarters.

BIGELOW-LIPTAK CORPORATION, Detroit, Mich., announces the apointment of Charles C. Plummer as manager of its sales office in Chicago. Mr. Plummer was formerly Chicago district manager for the R. H. Beaumont Company of Philadelphia. It is also announced that W. D. Dreiske, formerly in the Chicago office, has been transferred to the corporation's Detroit office as sales engineer.

WORTHINGTON PUMP & MACHINERY CORPORATION, New York City, announces the acquisition of the Gilman Manufacturing Company of East Boston, Mass., manufacturers of rock drilling equipment. This is part of Worthington's program to expand its line of pneumatic service to mines, quarries, contractors and industry, according to the announcement.

ST. JOHN X-RAY SERVICE CORPORATION, New York City, has arranged with the Westinghouse X-Ray Company to sell Westinghouse equipment in the industrial field.

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COMING CONVENTIONS

American Society of Mechanical Engineers. National Wood Industries Division. Meeting at the Hotel Pennsylvania, New York City, Oct. 16-17. Annual meeting in New York City, Dec. 1-5. National Fuels Meeting in Chicago, Ill., Feb. 10-13, 1931. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Engineering Council. Administrative board meeting at the Mayflower Hotel, Washington, D. C., Oct. 17-18. Secretary, L. W. Wallace, 26 Jackson Pl., Washington, D. C.

American Institute of Electrical Engineers. District meeting at Louisville, Ky., Nov. 19-22. Annual Winter convention in New York City, Jan. 26-30, 1931. Secretary, F. L. Hutchinson, 33 West 30th St., New York City.

American Society of Refrigerating Engineers. Annual meeting at the Hotel New Yorker, New York City, Dec. 3-6. Secretary, David L. Fiske, 37 West 39th St., New York City.

Midwest Power Engineering Conference and Exposition. Fifth meeting in Chicago, Ill., Feb. 10-13, 1931. Secretary, George E. Pfisterer, 308 West Washington St., Chicago, Ill.

National Association of Practical Refrigerating Engineers. Annual convention and exhibition at the Hotel Peabody, Memphis, Tenn., Nov. 11-14. Secretary, Edward H. Fox, 5707 West Lake St., Chicago, Ill.

National Power Show. Grand Central Palace, New York City, Dec. 1-6. Manager, Charles F. Roth, Grand Central Palace, New York City.

Society of Industrial Engineers. Seventeenth national convention at the Mayflower Hotel, Washington, D. C., Oct. 15-17. Secretary, George C. Dent, 205 West Wacker Drive, Chicago, Ill.

Stoker Manufacturers Association. Fall meeting at the Homestead, Hot Springs, Va., Nov. 3-5. Secretary, William V. McAllister, Foot of Walker St., Detroit, Mich.

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Trade Catalogs

CORRECTION—The Elliott Company of Jeannette, Pa., calls our attention to a mistake in listing two new bulletins of the company in our issue of Sept. 16. The correct listing is: Bulletins P-4 and P-5, describing centrifugal blowers and compressors. Also, the address given in our notice was that of the company's blower department in Philadelphia, not Pittsburgh as listed.

AUTOMATIC CONTROL—Catalog, "The Era of Automatic Control," Brown Instrument Company, Wayne and Roberts Aves., Philadelphia, Pa.

REFRACTORIES—Two illustrated booklets descriptive of "Quik-Pach" plastic fire brick and "Sairset" fire-brick mortar, A. P. Green Fire Brick Company, Mexico, Mo.

INSTRUMENTS—Illustrated leaflet describing a shunt-type tension indicator, Martin-Decker Corporation, 3431 Cherry Ave., Long Beach, Calif.

CHAINS—Illustrated catalog and data book on silent and roller chain drives, Union Chain & Manufacturing Company, Sandusky, Ohio.

STOKERS—Folder featuring "Pulverzone" automatic coal-burning equipment, Cokal Stoker Corporation, Wrigley Bldg., Chicago, Ill.

CONVEYORS—Folder No. 1248 describing the new "Cub" portable belt conveyor perfected by the Link-Belt Company, Chicago, Ill.

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Fuel Prices

FUEL OIL

New York—Oct. 9, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.5c.@5c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c.@6.25c. per gal.

St. Louis—Sept. 23, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.345 per bbl., or 42 gal.; 26@28 deg., $1.445 per bbl.; 28@30 deg., $1.545 per bbl.; 30@32 deg., $1.652 per bbl.; 32@36 deg., gas oil, 4.026c. per gal.; 38@40 deg., distillate, 4.651c. per gal.

Pittsburgh — Oct. 7, f.o.b. local refinery, 34@36 deg., fuel oil, 3.87½c.@4c. per gal.; 36@40 deg., 3.75c.@4c.

Philadelphia — Oct. 1, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 18 deg. plus, $1.475@$1.525 per bbl.; 23@27 deg., $2.00@$2.05 per bbl.

Cincinnati — Sept. 30, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Oct. 4, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 65c. per bbl.; 26@30 deg., 80c. per bbl.; 30@32 deg., 90c.@95c. per bbl.

Boston—Oct. 6, tank-car lots, f.o.b., 12@14 deg., Baumé, 3.1c. per gal.; 28@32 deg., 5c. per gal.

Dallas—Oct. 4, f.o.b. local refinery 26@30 deg., $1.10 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol.	New York	$1.90 @$2.25
Pool 10, hr.gr. low-vol.	New York	1.75 @ 1.85
Pool 11, low-vol.	New York	1.60 @ 1.75
Smokeless mine-run	Chicago	2.00
Smokeless slack	Chicago	.90 @ 1.25
S. E. Ky. slack	Chicago	.75 @ .80
Franklin, Ill. mine-run	Chicago	2.15
Franklin, Ill. screen	Chicago	1.35 @ 1.60
Ind. 5th Vein	Chicago	1.30 @ 1.60
Standard Ill. mine-run	St. Louis	1.65
W. Ky. mine-run	Louisville	.85 @ 1.25
W. Ky. slack	Louisville	.35 @ .50
Pittsburgh mine-run	Pittsburgh	1.35 @ 1.45
Smokeless, mine-run	Cincinnati	2.00 @ 2.25
Smokeless slack	Cincinnati	1.00 @ 1.25
Kanawha, mine-run	Cincinnati	1.15 @ 1.35
Kanawha, slack	Cincinnati	.40 @ .75

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat	New York	$3.50
Barley	New York	1.50

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ariz., Flagstaff—U. S. Property & Disbursing Officer, Phoenix, awarded contract for 18 mess halls, administration building, power house and guard house to H. R. Meadows, Phoenix, $58,887; warehouse, water and sewage systems to McGinty Construction Co., Phoenix, $31,016; infirmary, to W. H. Brown, Phoenix; and electrical distribution to C. W. Brown, Phoenix, for Fort Alexander M. Tuthill, near here. Total estimated cost $118,000.

Kan., Kansas City — City awarded contract for evaporators to Foster-Wheeler Corp., Dwight Bldg., Kansas City, Mo., superheaters to Schutte-Koerting Co., Dwight Bldg., and heaters to The Cockrane Corp., 17th Bl. and Allegheny Ave., Philadelphia, Pa., in connection with proposed improvements to power plant.

Kan., Topeka—Kansas Power & Light Co., Tecumseh, awarded contract for the construction of a power sub-station here to G. Senne, 1017 Kansas St. Estimated cost $20,000.

N. J., Jersey City — Bd. of Commissioners, City Hall, received lowest bid for a 3 story, 40 x 65 ft. addition to power house, laundry and tunnel at Baldwin and Montgomery Sts., from Auf Der Heide Contracting Co., 443 16th St., West New York. $302,500. Estimated total cost $800,000.

N. J., Jersey City — Mongiello Bros., 625 Communipaw Ave., will receive bids about Nov. 1 for the construction of a 100 x 100 ft. ice plant including ice making machinery, tank, etc. Estimated cost $50,000. C. H. Ziegler, 26 Journal Sq., is engineer.

N. J., Skillman — Dept. of Institutions & Agencies, State Office Bldg., Trenton, awarded contract for the construction of a 35 x 90 ft. power house at State Village for Epileptics here, to General Contracting & Construction Co., 133 East Front St., Trenton. Estimated cost $100,000.

N. Y., Flushing—Queensboro Hill Community Church, R. Anderson, 5812 134th St., will receive bids about Nov. 1 for the construction of a 1 story, 38 x 55 ft. boiler room and coal storage building at 138th St. and 60th Ave. Estimated cost $45,000. W. B. Willis, 171 Madison Ave., is architect.

N. Y., Syracuse — Syracuse Lighting Co., South Warren St., plans extensions and improvements to plant, including pumping plant, water gas plant, 10 m. cu.ft. capacity, gas holder 8 to 10 m. cu.ft. capacity, office building, service and storage building, garage, etc. Melvin & King, East Fayette St., are architects.

N. D., Williston — Great Northern Railway Co., St. Paul, Minn., awarded contract for foundation for power plant here, to C. Steen, Grand Forks, N. D. Estimated total cost $145,000. J. R. W. Davis, St. Paul, is chief engineer.

O., Dayton—Dayton Motor Freight Terminal Inc., c/o P. J. Altherr, 100 North Taylor St., plans the construction of a 2 story freight terminal, including loading platforms, storage space, offices, etc., at First and Taylor Sts. Estimated cost $100,000. Architect not selected.

Tex., Port Arthur — City is having preliminary surveys made for the construction of two small waterworks pumping plants. J. B. Converse Engineering Co., Port Arthur, are engineers.

Tex., San Antonio—City will receive bids until Oct. 20 for the installation of seventeen refrigerator display counters in municipal market house. Private plans.

Tex., Thorndale—City plans waterworks improvements, including pumping unit, etc. Estimated cost $40,000.

Tex., Waxahachie—City, c/o T. C. Cheatham, Mayor, plans waterworks improvements, including water well, pump, etc. Estimated cost $15,000. J. Rady, Waco, is consulting engineer.

Wash., Mount Vernon — City Commission, will soon award contract for the construction of a sewage system, including dry well, pump house, pumps, etc. Estimated cost $110,000. C. E. Dorisy, Republic Bldg., Seattle, is engineer.

Wash., Seattle—Textile Towers, Inc., awarded contract for the construction of a 17 story store and office building at 7th and Olive Sts. to Henrikson-Alstrom Co., Securities Bldg. Estimated cost $1,250,000. Four electric elevators will be installed.

Ont., Toronto—Bank of Nova Scotia, 39 King St. W., is having plans prepared for the construction of an office building, including steam heating system, elevators, etc., at King and Bay Sts. Estimated cost $2,000,000. J. M. Lyle, 230 Bloor St. W., is architect.

Ont., Toronto—Toronto Hydro-Electric Commission, 225 Yonge St., is having plans prepared for the construction of an electric substation, including equipment, etc., on George St. Estimated cost $100,000. Private plans.

Equipment Wanted

Boiler and Filters—Louisville, Ky.—City will receive bids until Oct. 28 for new boiler and water filters, 36 m.g.p.d. capacity for proposed improvements to waterworks.

Engines—Houston, Tex.—Harris County, c/o H. L. Washburn, Auditor, will receive bids until Oct. 20 for two 50 hp. solid injection Diesel type engines for Ferry.

Power Unit—Berea, O.—Bd. of Public Affairs, T. R. Barnum, Pres., plans to purchase a 1,000 kw. unit to increase capacity of electric light plant.

Pumps—Torrance, Calif.—Municipal Improvement Dist. No. 1, pumps, etc., for proposed waterworks and distribution systems. Estimated cost $400,000.

Pumps—Niagara Falls, Ont.—Bd. of Water Commissioners, City Hall, will receive bids until Oct. 15 for one high pressure and three low lift pumps, and motors with valves, piping and necessary electrical equipment for proposed waterworks. Estimated cost $30,000.

Pumps, Motors, Transformers, etc.—Trenton, N. J.—City Commission, will receive bids until Oct. 24 (extended date), for two 20 m.g.p.d. DeLaval centrifugal pumps, one 200 kw. rotary converter, switchboard and transformer for municipal waterworks. Estimated cost $50,000.

Industrial Projects

Calif., Oakland — Hammer Bray Co., 26th Ave. and East 12th St., manufacturers of stoves, etc., is having plans prepared for the construction of a factory at 102nd Ave. Estimated cost $200,000. C. N. Burrell, American Bank Bldg., is architect.

Ill., Chicago—Ideal School Supply Co., 8316 Birkhoff Ave., awarded contract for the construction of a 1 story, 60 x 120 ft. woodworking plant to The Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $50,000.

Mass., Pittsfield—General Electric Co., E. A. Wagner, Gen. Mgr., is having plans prepared for a 1 story, 150 x 600 and 30 x 350 ft. transformer tank plant at Tyler St. and Benedict Rd. Estimated cost $1,000,000. Private plans. Testing, sand blasting, welding and baking equipment will be required.

Mich., Detroit—Mitchell & Smith, Inc., Copeland St. (cork insulation) awarded contract for a 1 story, 46 x 200 ft. addition to cooling plant to The Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $40,000.

N. J., Newark — M. N. Shoemaker, 10 Bleecker St., Archt., will receive bids about Oct. 15 for the construction of a 2 story factory at 361-65 6th Ave., for Weldron Roberts Rubber Co., 18 Oliver St. Estimated cost $40,000.

N. Y., Brooklyn — Wheeler Holding Corp., 18th St. and Coney Island Creek, is having sketches made for a 120 x 245 ft. boat building plant and boat house at West 18th St. and Ave. Z. Estimated cost $45,000. H. E. Wheeler, 1540 Brooklyn Ave., is architect.

N. Y., Stapleton—Rubsam & Horrman Brewing Co., 191 Canal St., will receive bids about Nov. 1 for the construction of a brewery, ice manufacturing plant and storage building. Estimated cost to exceed $300,000.

O., Cleveland—Roberts Realty Co., c/o L. Skolnik, Auditorium Garage Bldg., Archt., had plans prepared for a 1 story, 47 x 108 ft. reflector factory at 3856 Woodland Ave. Estimated cost $40,000.

Pa., Oil City—Pennzoil Oil Co., R. Fox, Drake Theatre Bldg., awarded contract for the construction of a refinery (cracking unit), to A. G. McKee & Co., 2422 Euclid Ave., Cleveland, O. Estimated cost $500,000. Complete equipment will be required.

Wis., Lake—Wrought Washer Co., 465 Bay St., Milwaukee, is receiving bids for a 65 x 500 ft. rolling mill, 65 x 385 ft. storage house and 100 x 250 ft. shipping department on Oklahoma St. Klug & Smith, 69 East Wisconsin Ave., Milwaukee, are engineers.

Ont., Guelph—Light & Heat Commission, J. Heeg, Mgr., City Hall, awarded contract for a new civic gas plant to West Gas Improvement Co., 441 Lexington Ave., New York, N. Y. Estimated cost $100,000.

Quebec — American Brake Shoe & Foundry Co., 230 Park Ave., New York, N. Y., plans the construction of a steel mill, foundry, etc., here.

Industrial Building This Year

Contracts awarded for industrial buildings of $40,000 or more in the first nine months of 1930 number 1,303 and total in value $274,431,000. This is an average of $210,000 per project. Number and value of awards in several industries important to the power field are given below.

	No.	Value
Aircraft	4	$2,080,000
Automotive	18	5,500,000
Clay products	11	914,000
Coke	4	1,179,000
Cold storage	10	5,847,000
Elec. power plants	156	79,286,000
Foundries	24	1,740,000
Iron and steel products	54	28,563,000
Machine shops	65	5,062,000
Paper and pulp	10	4,397,000
Printing	34	6,736,000
Textiles	20	1,920,000
Other industries	893	131,207,000
	1,303	$274,431,000

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

A WIDE variety of materials were subjected to price declines during September. The downward movement affected mainly hose, belting, cotton waste, babbitt metal, armored cable, N.E.C. fuses in standard packages, fuse plugs, and rubber-covered copper wire. The reductions were not unduly sharp but seemed, instead, merely to follow the downward trend observed in commodities prices generally. An exception is seen in the case of rawhide lacing, which rose about 2c. per sq.ft. over last month's levels. A slight pick-up, reported in inquiries for packing and insulating material, is believed to be more than seasonal.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket, net, per ft		$0.65
Common, 2½-in., cotton, rubber-lined, 80c. per ft., list, less		50–10%
	Air—Best Grade, Net	
¾-in., per ft	3-ply $0.30	4 ply $0.36
	Steam—Discounts from List	
First grade 50%	Second grade 50–5%	Third grade 60–5%

RUBBER BELTING—List price, 6-in., 6 ply, $1.83 per lin.ft. The following discounts from New York warehouse list apply to rubber transmission belting:

Best grade 60% Second grade 60-5%

LEATHER BELTING—List price, 24c. per lin.ft., per inch of width, for single ply, at New York warehouses in quantities of about ½ doz. rolls:

Grade	Discount from list
Medium	30-10%
Heavy	30%

RAWHIDE LACING—Cut lacing, best quality, 30-10%; 2nd quality, 50%. Lace leather sides, best, 12-17 sq.ft., 55c. per sq.ft.; 2nd, 48c., net. Giant or Indian tanned cut lacing, 30-10%.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ⅛ in.	$0.90
Asbestos for high-pressure steam, ½ in.	1.75
Duck and rubber for piston packing	.90
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.20
Rubber sheet	.45
Rubber sheet, wire insertion	.75
Rubber sheet, duck insertion	.55
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ½- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts from list at New York warehouses are as follows:

85% magnesia, high pressure		40 %
Asbestos, air cell, for low-pressure heating and return lines	4-ply	65 %
	3-ply	67½%
	2-ply	70 %

PORTLAND CEMENT—New York, $2.10 per bbl., without bags, delivered by truck to site of job. Bag charge, 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, beams and channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3-in. and larger; and plates, ¼-in. thick and heavier; all $3.10 per 100 lb. in lots of 400 to 3,999 lb.

COTTON WASTE—The following prices are in cents per lb., at warehouse:

	New York	Cleveland	Chicago
White	13.00	16.00	15.00
Colored	9.50	12.00	10.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed white wipers, as follows:

Chicago (100 lb. bales)	$0.14½
New York (100 lb. bales)	.14
Cleveland (per thousand)	38.00

LINSEED OIL—These prices are for raw oil in barrels, f.o.b., in 1 to 4 bbl. lots:

	New York	Minneapolis	Chicago
Per pound	$0.106	$0.115	$0.108

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b., New York:

	Dry	In Oil
Red	$13.75	$15.25
White	13.75	13.75

RIVETS—The following quotations apply on fair-sized orders from warehouse:

Tank rivets, $\frac{7}{16}$-in. diameter and smaller, list (Apr. 1, 1927) less 65% in full packages, for immediate delivery from warehouse stocks in New York and vicinity.

Structural rivets, ½-in., round head, per 100 lb.:

New York	$4.50*
Chicago	4.00
Pittsburgh mill	2.75

*This price is for full kegs; broken kegs are $6.00 per 100 lb.

REFRACTORIES—Prices in car-loads, f.o.b. plant:

Chrome brick, eastern shipping points	per net ton	$45.00
Chrome ore, ground, 40@50%, Cr_2O_3, in bulk	per net ton	22@25
Chrome ore, ground, 40@50%, Cr_2O_3, in sacks	per net ton	26@29
Chrome ore, crude, 40@50%, Cr_2O_3	per net ton	18.00@22.50
Magnesite brick, 9-in. straights	per net ton	65.00
Magnesite brick, 9-in. arches, wedges and keys	per net ton	71.50
Magnesite brick, soaps and splits	per net ton	91.00
Silica brick, Mt. Union, Pa.	per M	43.00
Clay brick, 1st quality, 9-in. shapes, Pennsylvania	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Colorado	per M	40@43
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	35@38

BABBITT METAL—Delivered in case lots from New York warehouse, on orders of 100 lb. or over, cents per pound:

Genuine, highest grade	48.00
Commercial genuine, intermediate grade	35.00
Anti-friction metal, general service	30.00
No. 4 babbitt, f. o. b.	10.25

COLD-FINISHED STEEL—Shafting and screw stock, warehouse prices per 100 lb., base, are as follows:

	New York	Cleveland	Chicago
Round or hexagon	$3.40	$3.65	$3.35
Flat or square	3.90	4.15	3.85

BOILER FITTINGS—F.o.b. warehouse, Jersey City, N. J., discounts from list:

Copper ferrules	70%
Boiler flanges	65–5%
Boiler stay bolts	60%
Boiler patch bolts	20%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following basing discounts from list are for large mill lots at Pittsburgh mill:

BUTT WELD

	Steel			Iron	
Inches	Black	Galv.	Inches	Black	Galv.
1 to 3	64%	52½%	1 and 1¼	31%	15%

LAP WELD

2	57%	45½%	2	23%	9%
2½ to 6	61%	49½%	2½ to 3½	28%	13%
7 and 8	58%	45½%	4 to 6	30%	17%
9 and 10	56%	43½%	7 and 8	29%	16%
11 and 12	55%	42½%	9 to 12	26%	11%

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	62%	51½%	1 to 2	34%	18%
2 to 3	63%	52½%			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	55%	44½%	2	29%	13%
2½ to 4	59%	48½%	2½ to 4	34%	20%
4½ to 6	58%	47½%	4½ to 6	33%	19%
7 and 8	54%	41½%	7 and 8	31%	17%
9 and 10	47%	34½%	9 to 12	21%	8%
11 and 12	46%	33½%			

BOILER TUBES—Standard gage, manufactured in accordance with the specifications and requirements of the American Society of Mechanical Engineers and in compliance with the rules and regulations of the U. S. Steamboat Inspection Service, from New York warehouse stock, per 100 ft.:

Size, Inches*	B.W.G.	Toncan Seamless Iron	Knobbled Charcoal Iron	Seamless Steel	Lapwelded Steel
1	13	$34.00	.....	$18.00	.....
1¼	13	37.75	.....	20.25	.....
1½	13	38.00	$38.00	19.25	.....
1¾	13	30.00	30.00	22.00	.....
2	13	26.25	26.25	20.25	$19.00
2¼	13	34.50	34.50	23.00	25.00
2½	12	34.00	34.00	26.00	24.25
2¾	12	40.50	40.50	28.50	27.50
3	12	42.50	42.50	27.00	25.50
3½	11	50.25	50.25	30.75	28.75
3½	11	54.50	54.50	33.25	31.50
4	10	67.00	67.00	40.00	38.00

These prices are based on stock lengths. If cut to special lengths billing will be based on the entire stock lengths. In addition to the foregoing, standard cutting charges are as follows:

2-in. and smaller.. $0.05 per cut
2¼ and 2½ in..... .06 per cut
3-in..... $0.09 per cut
3½ to 4 in.. .10 per cut

*External diameter.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft., New-Style, A.B.C., with fibre bushing:

B. & S. Size	BX Two Cond. M. Ft.	BX Three Cond. M. Ft.	Lead Two Cond. M. Ft.	Lead Three Cond. M. Ft.
No. 14 solid....	$23.37	$38.24	$66.00	$86.75
No. 12 solid....	38.02	50.52	76.00	104.00
No. 10 solid....	52.19	66.22	95.00	124.00
No. 8 stranded..	85.34	105.22	133.00	185.00
No. 6 stranded..	123.58	148.81	180.00	253.00

Coils to 1000 ft., +10%; less than coil lots, +20%.

CONDUIT—Rigid iron, price per 1,000 ft.; **ELBOWS AND COUPLINGS,** per 100 pieces, extra. Delivered from New York warehouse. Discount of 5 per cent for payment in 10 days; 30 days net.

Size, Inches	GALVANIZED Conduit	GALVANIZED Elbows	GALVANIZED Couplings	BLACK Conduit	BLACK Elbows	BLACK Couplings
¾	$60.89	$8.31	$4.79	$55.67	$7.14	$4.36
¾	77.61	10.94	6.85	70.53	9.41	6.24
1	111.26	16.35	8.94	100.80	14.07	8.14
1¼	150.53	22.47	12.59	136.38	19.71	11.54
1½	180.00	30.05	15.59	163.08	26.35	14.29
2	242.20	54.69	20.87	219.43	47.92	19.15
2½	382.95	90.49	29.81	346.95	79.41	27.34
3	500.80	233.74	44.70	453.72	204.21	41.01
3½	630.74	511.83	59.92	574.14	446.60	55.00
4	769.61	591.84	74.69	702.53	516.46	68.53
4½	896.51	892.12	111.40	818.37	777.99	102.16
5	1045.06	1240.73	122.91	953.99	1082.29	112.75
6	1355.64	1547.71	177.72	1237.49	1350.80	162.95

CONDUIT BODIES AND FITTINGS—Black or galvanized:

	Less Than $15 List	$15 List to $100	$100 List and Over
Standard package	15%	20%	28%
Less than standard package	10%	15%	20%

CUT-OUTS—Following are net prices, each, in standard-package quantities:

CUT-OUTS, PLUG, SOLID, NEUTRAL OR 2-FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID, NEUTRAL OR 2-FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy		$15.00
No. 16 cotton reinforced heavy		19.00
No. 18 cotton reinforced light		12.00
No. 16 cotton reinforced light		14.00
No. 18 cotton Canvasite cord		13.00
No. 16 cotton Canvasite cord		15.00
No. 16 super service cord or similar (2 wire) in 1,000 ft.	$64.00	*71.00
No. 14 super service cord or similar (2 wire) in 1,000 ft.	92.00	*101.00

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List Each
3-amp. to 30-amp.,	100	$0.15	3-amp. to 30-amp.,	100	$0.30
35-amp. to 60-amp.,	100	.30	35-amp. to 60-amp.,	100	.60
61-amp. to 100-amp.,	50	.90	65-amp. to 100-amp.,	50	1.50
101-amp. to 200-amp.,	25	2.00	110-amp. to 200-amp.,	25	2.50
201-amp. to 400-amp.,	25	3.60	225-amp. to 400-amp.,	25	5.50
401-amp. to 600-amp.,	10	5.50	450-amp. to 600-amp.,	10	8.00

Discount: Less than one-fifth standard package, 60%; one-fifth to standard package, 65%; standard package, 70%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.....	$0.50	$1.10	100	10
35 to 60-amp.....	1.00	1.25	100	10
65 to 100-amp.....	2.00	3.00	50	5
110 to 200-amp.....	4.00	5.00	25	5
225 to 400-amp.....	7.50	11.00	25	1
450 to 600-amp.....	11.00	16.00	10	1

REFILLS—

1 to 30-amp.....	$0.03 ea.	$0.05	100	100
35 to 60-amp.....	.05 ea.	.06	100	100
65 to 100-amp.....	.10 ea.	.10	50	50
110 to 200-amp.....	.15 ea.	.15	25	50
225 to 400-amp.....	.30 ea.	.30	25	25
450 to 600-amp.....	.60 ea.	.60	10	10

Discount Without Contract—Fuses:
Broken cartons..... Net list
Unbroken cartons..... 17%
Ten unbroken cartons..... 34%

Discount Without Contract—Renewals:
Broken cartons..... Net list
Unbroken cartons..... 17%
Ten unbroken cartons..... 34%

Discount With Contract—Fuses:
Broken cartons..... 5%
Unbroken cartons..... 20%
Ten unbroken cartons..... 36%

Discount With Contract—Renewals:
Broken cartons..... Net list
Ten unbroken cartons..... 36%

Carton quantities may be combined to obtain maximum discounts.

FUSE PLUGS, MICA CAP—

0–30 ampere, standard package (500), per 100	$2.50
0–30 ampere, less than standard package, per 100	2.75

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard, A type bulbs:

100—130 Volt Watts	General Type	Price Each	200—260 Volt Watts	Special Type	Price Each
15	A 17	$0.20	25	A 19	$0.25
25	A 19	.20	50	A 21	.25
40	A 21	.20	100	A 23	.45
50	A 21	.20	...	....	.....
60	A 21	.20	...	....	.....
100	A 23	.35	...	....	.....

Carton quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net, allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain, separable, attachment plug	$0.18
Composition, 2-piece, attachment plug	.27
Swivel attachment plug	.12
Small size, 2-piece plug, composition	.06

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f.o.b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Solid Duplex
14	$5.00	$6.80	$7.40	$13.20
12	6.90	8.70	9.60	17.00
10	7.40	11.20	12.50	22.50
8	13.70	16.15	18.10	32.00
6	.....	.....	25.00	.....
4	.....	.....	35.00	.....
2	.....	.....	50.50	.....
1	.....	.....	74.50	.....
0	.....	.....	88.00	.....
00	.....	.....	102 00	.....
000	.....	.....	122.50	.....
0000	.....	.....	151.00	.....

SOCKETS, BRASS SHELL—Price each, net:

	½ In. or Pendant Cap Key	½ In. or Pendant Cap Keyless	½ In. or Pendant Cap Pull	¾ In. Cap Key	¾ In. Cap Keyless	¾ In. Cap Pull
Standard package	$0.12	$0.10	$0.16	$0.16½	$0.14	$0.20
Unbroken carton	.14	.12	.18	.18	.16	.21
Broken carton	.16	.14	.20	.20	.18	.24

WIRING SUPPLIES—

Friction tape, ¾ in., in less than 100 lb., 30c. per lb.; in 100 lb. lots, 28c. per lb.
Rubber tape, ¾ in., in less than 100 lb., 32c. per lb.; in 100 lb. lots, 29c. per lb.
Wire solder, in less than 100 lb., 30c. per lb.; in 100 lb. lots, 28c. per lb.
Soldering paste, 2 oz. cans..... $1.10 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c or a.c., N.E.C.:

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$3.50	$5.70	$9.00
60	9.00	11.00	14.00
100	14.00	17.00	29.00
200	22.00	29.00	48.00

Discounts:
Standard package..... 40%
Less than standard package..... 35%